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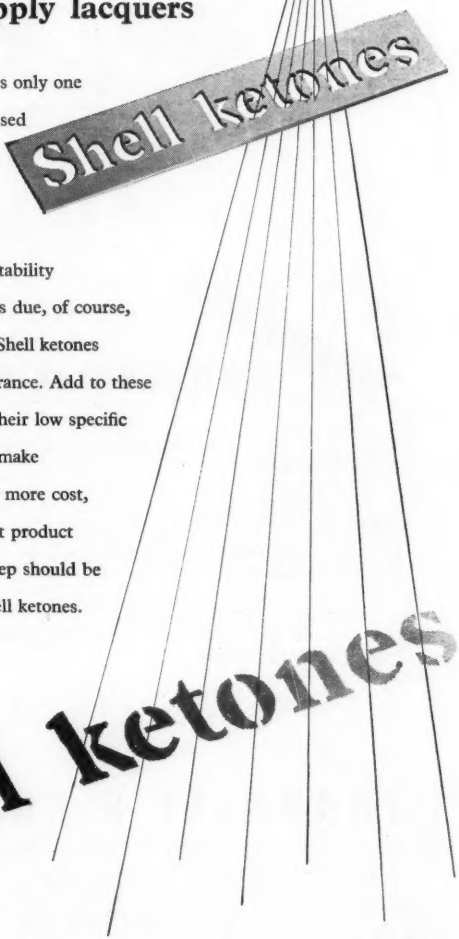

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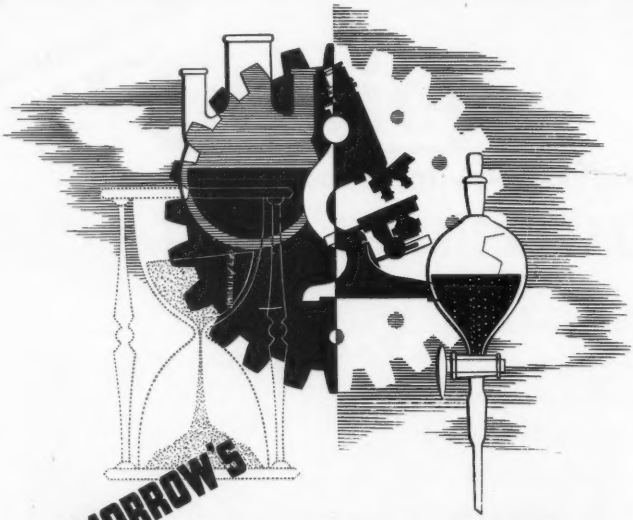

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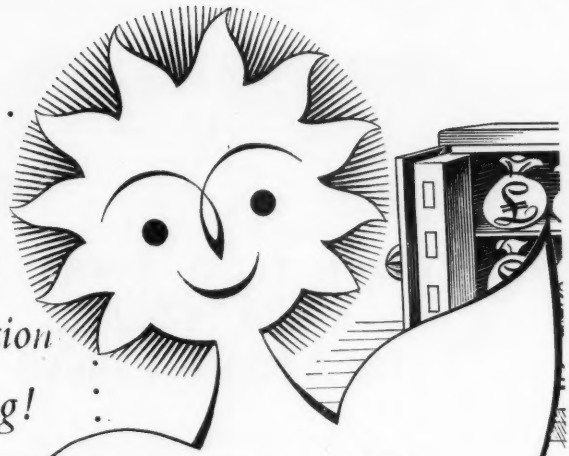

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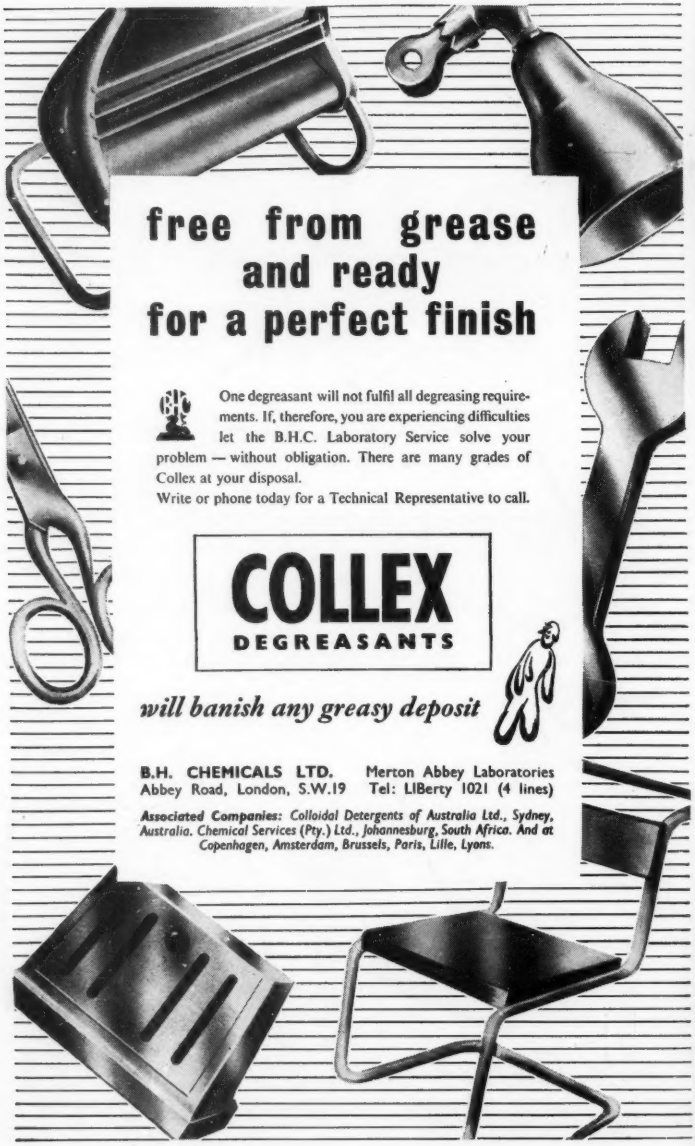
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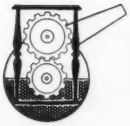

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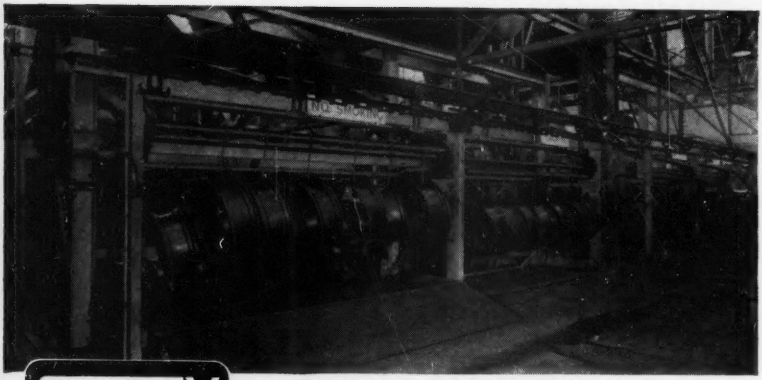
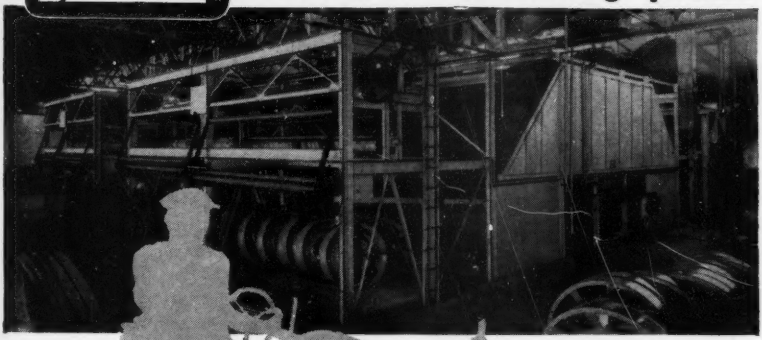


STORDY modern finishing plant



This plant was designed for a fully mechanised dipping and stoving operation for Tractor wheels. Heating is by direct oil firing and the combined crossbar width of the two ovens is 42 ft. The installation included three paint storage tanks of 4,500 gallons capacity and two of 3,500 gallons capacity, together with paint circulating equipment. This is one example of a complete finishing scheme designed and engineered by Stordy . . . equipment is built for the complete cycle in the application of paints, varnishes and all metal finishes including pretreatment and mechanical handling.
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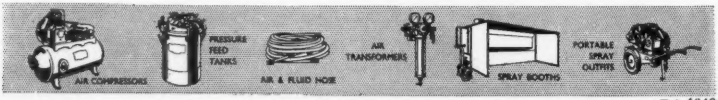

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Lewis Berger & Sons Ltd., Styrene Co-Polymers Ltd. (their Licencees), and Beck, Koller & Co. (England) Ltd., jointly announce agreement relating to their respective patents covering the field of styrene co-polymers.

Each Company recognises the validity of each other's patents in this field. The existing patent specifications are as follows:—

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573,835	611,109	634,570
580,912	615,802	640,832
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605,929	622,948	649,443
609,749	622,949	654,031
		675,761

BECK, KOLLER:

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Royalty payments by the Companies are a provision of this Agreement and for example will accrue in respect of the Beck, Koller product STYRESOL 9255, which, like Styrene Co-Polymers' product SCOPOL 71X, is manufactured under Berger patents.

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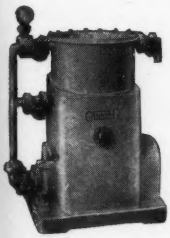
"Tynee" Portable Filter Unit

(Right) *The "Tynee" Portable Filter Unit has been specially designed to meet the needs of small capacity electroplating plants. It is easy to manoeuvre in congested areas, simple to clean and thoroughly reliable.*



"Rotunda" Filter Unit

(Left) *"Rotunda" Filters are made in three capacities—300, 500 and 1,000 gallons per hour, and consists of an outer rubber-lined container fitted with an internal lid carrying the filter sleeves, and an outer lid to seal the container. A motor-driven pump is mounted underneath the Container and valves are provided for backwashing when necessary.*
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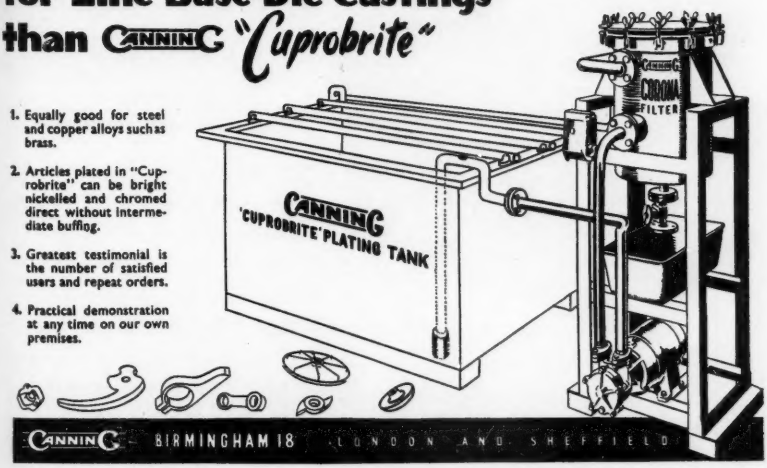

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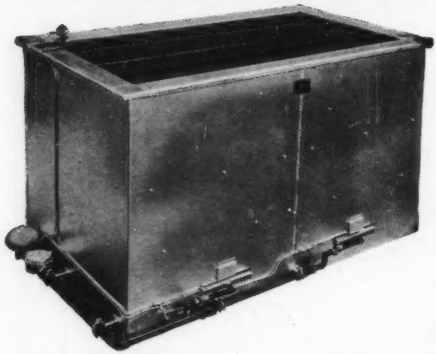

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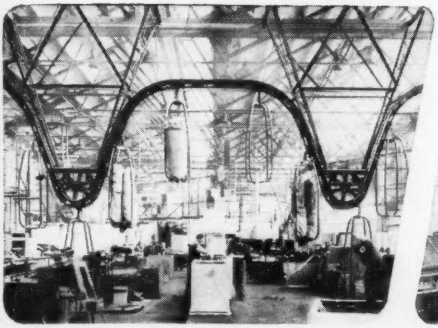
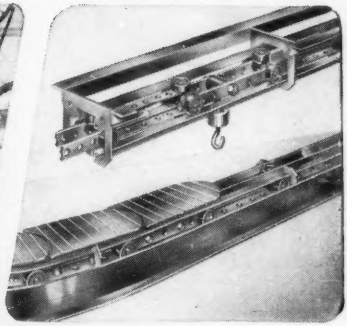
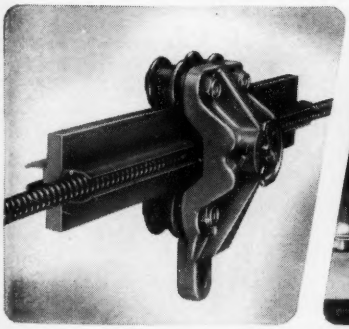
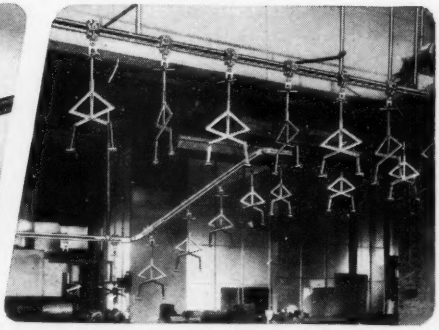




TELEFLEX CONVEYORS



Top left installation photograph by courtesy of the Frigidaire Division of General Motors Ltd.



Lower right installation photograph by courtesy of A. C. Sphinx Sparking Plug Co. Ltd.

For "Medium Duty" Conveying—the chain conveyor shown in the top illustrations is designed to carry substantial loads. The principle of chain and guides is clearly shown in the top right inset, whilst adaptation to a platform conveyor is apparent from the lower right inset. For "Light-Duty" Conveying—the unique cable conveyor shown in the lower illustration. The inset illustration exemplifies the simple and sound construction used in manufacture.

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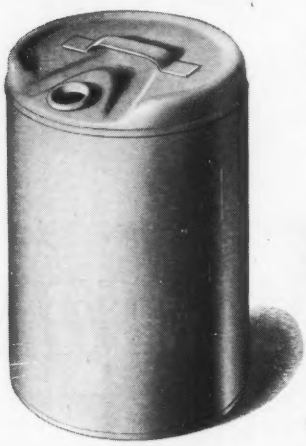

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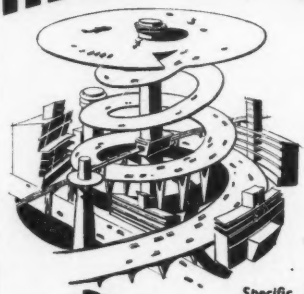

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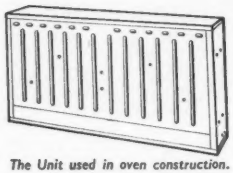
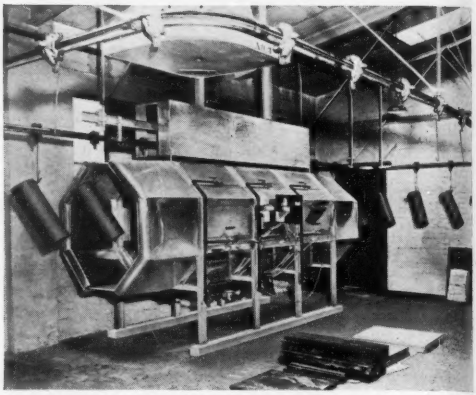


The Unit used in oven construction.



A tunnel of Bratt Colbran Radiant Units stoving finishes on food canisters.

(Photo by courtesy of Messrs. Grundy (Teddington) Limited).

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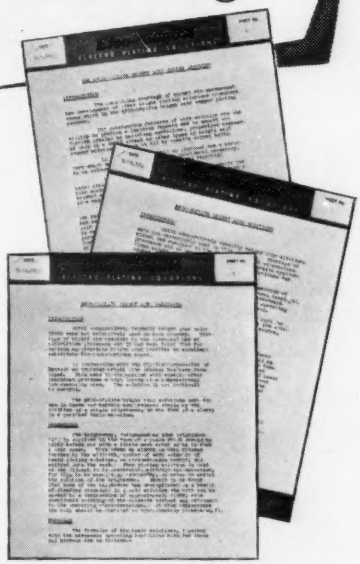

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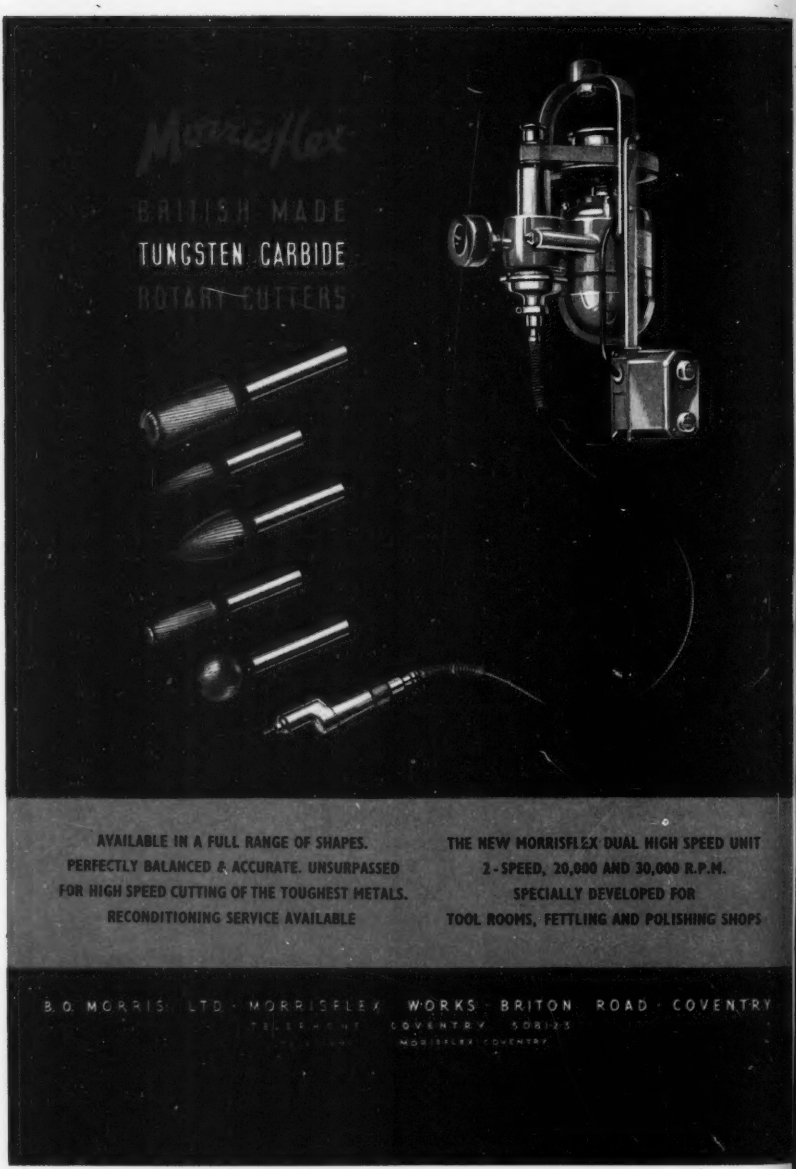

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INDUSTRIAL FINISHING

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JANUARY 1953

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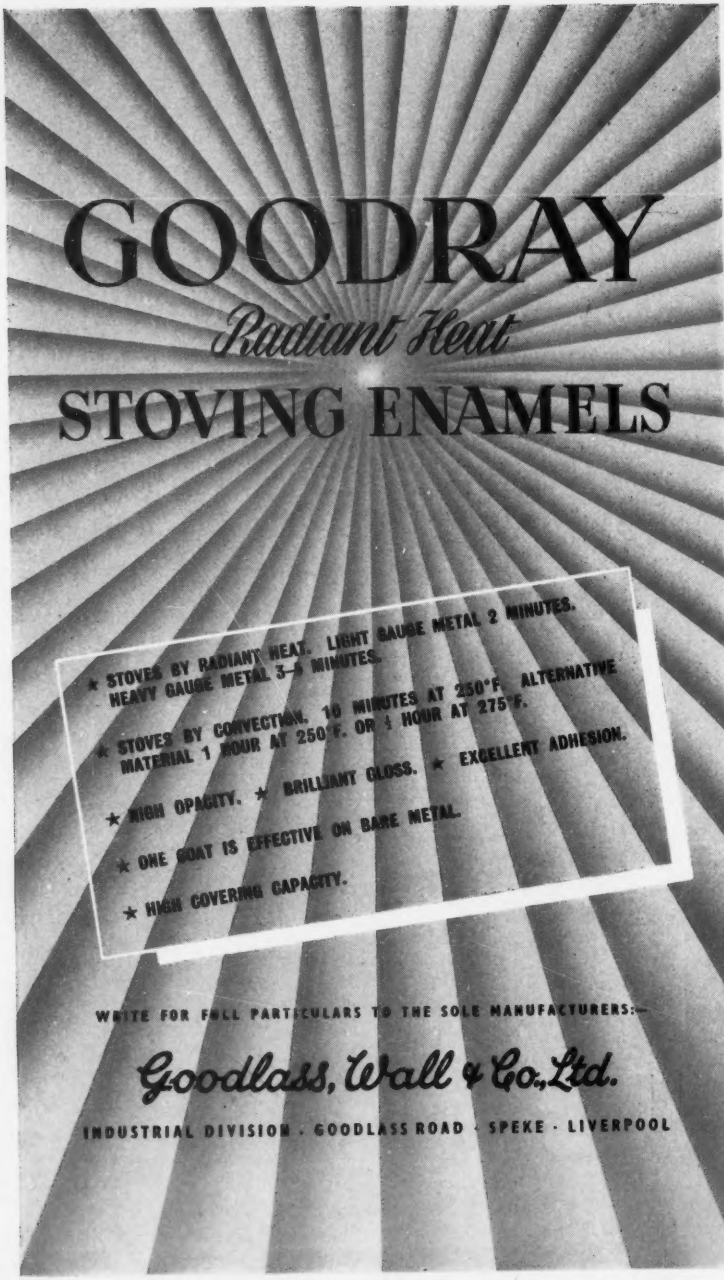
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Industrial Finishing

VOL. 5 JANUARY, 1953 NO. 55

FUEL ECONOMIST

THE publishers of this journal have decided to extend their scope in the field of technical publications to include a new journal with the title *Fuel Economist*. Recently, in the editorial to the first edition, the policy of the new journal was laid down as follows:

1. The paper accepts that nationalisation, in one form or another, of the coal, electricity, and gas industries, is a *fait accompli*, and that their return to private enterprise conditions as known prior to 1939 will not take place in this generation. Assuming this true, the necessary transition will be from nationalisation as it is now understood towards an integration of the industries, each maintaining its autonomy within an integrated policy.

2. *Fuel Economist* believes it is unhealthy for the nation that there should be bitter competition (as at present understood by the word) between these industries and it is vitally important that they work together as harmoniously as possible in the interest of the nation. Of course, human nature being such as it is, there will be a healthy form of competition between the three, but *Fuel Economist* would rather that the competition was to be compared with the respective "houses" at a school, whose separate interests, in the end, are merged to the ultimate benefit of the whole school itself when the occasion arises.

3. *Fuel Economist* accepts that the fundamental consideration of the three nationalised industries is not towards these industries themselves, but the community in general.

Out of these axioms come the considerations which will bring about a desirable state of affairs in Britain in so far as fuel is concerned:

(i) A tremendous problem lies ahead in educating the consumer of the real need for economy in fuel utilisation and, simultaneously, how this can be achieved.

(ii) *Fuel Economist* will see to it that the consumer is adequately informed on every aspect of ideas or equipment leading to this essential end.

(iii) *Fuel Economist* will ensure that local authorities, parliamentarians, economists, fuel engineers, and distributors of fuel appliances are accurately informed on matters appertaining to the improved utilisation of fuel.

(iv) Britain has one indigenous source of chemicals and

energy. It is coal. Germany built a chemical economy on coal during World War II. No other industrial nation wastes the potential energy in coal to the extent that happens in Britain. And Britain cannot afford much longer to waste its cheapest raw material.

A few points at random can be selected. Solid fuel room-heating appliances of more than 40 per cent. efficiency must be encouraged; the production of high-efficiency open fires of the utility type capable of easy installation into existing fire openings, and with convection heat and a restricted throat, are important. Production of simple devices to insert into existing flues to restrict the chimney throat will show immediate dividends.

Particular stress will be laid upon the advantages of correct insulation for domestic premises and factories. *Fuel Economist* will agitate for real financial incentives to those who install efficient fuel appliances and use adequate insulation. The paper will provide advice on fuel efficiency.

But, above all, *Fuel Economist* will seek to keep the responsibility for producing and manufacturing gas, electricity, and coal in the hands of the present managers and oppose most rigorously the suggestion of the Ridley Report that an external authority such as a national planning committee or an external tariffs advisory committee, having authority without responsibility, should be saddled upon the present managers of the fuel industries.

The first issue of *Fuel Economist* was distributed with a number of copies in excess of 7,000. Among its readers will include gas and electrical engineers and Coal Board officials. It will be seen by retailers of solid fuel appliances—by the gas showrooms—by ironmongers—by architects and local authorities—by members of the various fuel consultative committees up and down the country—by manufacturers and progressive lay opinion.

Fuel Economist welcomes comment from all sources, providing there is real interest in fuel conservation. It will report the fuel discussions in Parliament and at Consultative Council level. It will describe steps which can be taken in fuel economy now.

In short, it will live up to its title of *Fuel Economist* with a clearly defined editorial policy directed at a clearly defined readership which, on the first issue, amounted to at least 30,000 people all interested in shaking fuel policy free from dogma.

Fuel Economist will constructively criticise towards placing fuel economics in correct perspective as a vital tool to British economy, which means better living standards.

Everything must begin some place—*Fuel Economist* runs at the moment to twenty-four pages, but unbiased and informed opinion tells us that a truly independent paper of fuel economics grinding neither the axe of a Government department nor that of a particular fuel industry is very much needed. The Editor seeks the support and co-operation of all interested in this worthy theme.

In so far as the finishing engineer is concerned, fuel costs play an important part in the overall cost of a job. There is no doubt that hundreds of thousands of therms are literally wasted by insufficient attention to insulation of process tanks. The stoving oven can be an efficient unit, or extremely wasteful. Likewise, the heavy fuel consumption for galvanizing and vitreous enamelling involve operations which, if not viewed with care, can literally eat money. All fuels, including oil, gas and electricity, have their protagonists but in the pages of *Fuel Economist* the claims will be dealt with dispassionately and impartially.

BARREL FINISHING

by

FRANK SPICER

BARREL finishing consists of rolling the work in a special type of barrel, in conjunction with a cutting or non-cutting medium, with or without a fluid addition. Some parts are so designed that they can be rolled, without any other addition; such parts are termed self-rolling.

The applications of barrelling are:

1. De-burring, and generation of a radius.
2. Abrasive burnishing or polishing to almost any degree of finish.
3. Ball burnishing for higher lustre and colour.
4. Grinding or cutting down such as castings, etc.
5. Scale removal.
6. Blending of parting lines, gates or sprues.
7. Cleaning to remove oil, grease, etc.
8. Production of surfaces to replace lapping and finely ground surfaces.
9. Decreasing surface porosity, and improving surface conditions for electroplating.
10. Surface hardening of brass, steel, etc.

Limitations

Barrel finishing cannot be expected to be a complete finishing operation and for every metal part, complicated shapes cannot be tumbled. Major cutting down cannot be done, i.e., heavy flashes should be removed prior to barrelling.

Flat plain objects are to be avoided;

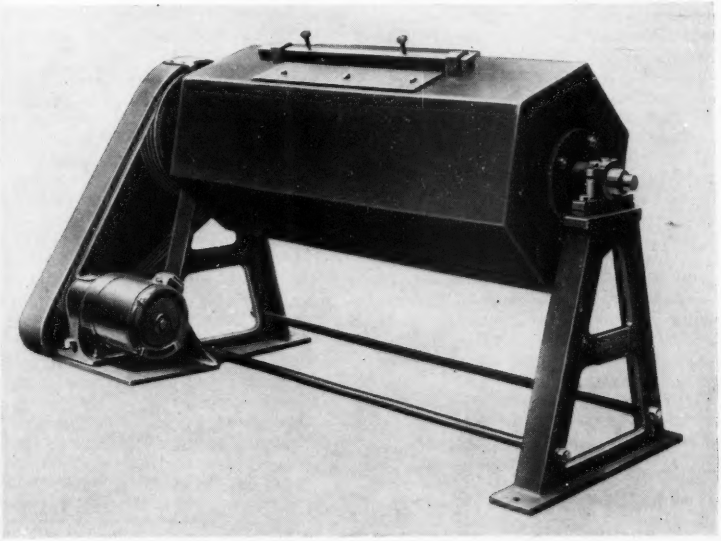

Fig. 1

hollow shapes, the interior of which are to be highly finished are also things to avoid. Barrelling will not remove excessively deep tool marks, unless the tumbling period is extended unnecessarily.

However, barrel finishing has decided advantages, such as:

1. Finishing costs can be reduced considerably.
2. Production can be maintained.
3. Many finishes can be obtained from a complete installation.
4. Product uniformity is assured.
5. Modern methods lack impingement as of old.
6. Cleaner and brighter surfaces are possible.
7. Decreased surface porosity.
8. Reduction of rejects.
9. Labour costs are reduced considerably.
10. Tool finishing times reduced.
11. Total elimination of certain operations, mainly of course hand polishing.

Types of Barrels

No one type of barrel will accomplish all jobs, although one barrel will process articles of different types, and only experience or experimentation will determine the best type. Roughly, barrels are of two types—open or closed—we can again sub-divide them into methods of motion, i.e., horizontal, vertical or obliquely.

Horizontal barrels.—Close horizontal barrels are the most widely used, and vary in shape and size, the diameter may be anything from 12 in. to 6 ft., and of one or two shapes, i.e., hexagonal and round (see Fig. 1). These barrels are mounted upon a central shaft and are usually fitted with variable speed controls, depending upon the material to be treated; these barrels may be of steel and if necessary wood lined, or may be constructed of wood.

Oblique type barrels.—These are usually constructed with open end as shown in Fig. 2 and so arranged to enable the barrel to be emptied by tilting, the angle of rotation may also be varied.

Cylindrical barrels provide smooth work movement and lessens the danger of impingement.

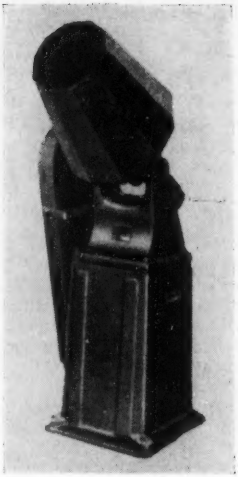

Fig. 2

Multiple tumbler units are available in either open or entirely closed construction.

Abrasive Media

The quality and types of abrasive available for barrel finishing are many and varied and each one will be reviewed separately.

1. Steel Balls, Stars, etc.—These should be of a fine quality hardened steel, and great care should be taken of them. When not in use, to prevent them from rusting, they should be kept immersed in a solution of sodium carbonate. These steel shapes really give a best performance if used after a cutting down operation, and, strange as it may seem, the softer the steel balls the greater the cutting action.
2. Granite Chips.—These possess a quicker action in de-burring; larger chips grind down quicker, but leave a coarser finish than the smaller ones. A combination of the two is often used. Care must be taken when using chips to ensure they are not too small, allowing them to wedge themselves in drilled holes of components, etc.

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3. Lime-stone Chips.—Used mainly for a cutting action.
4. Sawdust.—A burnishing or polishing medium.
5. Leather Mousings. — Polishing media.
6. Felt Pieces.—If used in conjunction with oil and emery can give a fine finish on steel components.
7. Abrasive powders, from 20 to 150 are used in conjunction with detergents, lubricants and cleaners.
8. Non-cutting media, such as chemicals, soaps, detergents, etc.
9. Artificial Stone.—Usually of porcelain in a variety of shapes.
10. Zinc Pellets.—Used for burnishing of hardened steel or stainless steel.
11. Wooden Blocks.—Mainly for burnishing.

Compounds

The liquid media should lubricate both abrasive and article; it should not form adherent films that are difficult to wash off, be chemically inert to abrasive, article and barrel, be non-toxic, easy to handle, obtain and store, and most important, should not be costly.

Solutions are used in barrels to prevent impact, clean surfaces and

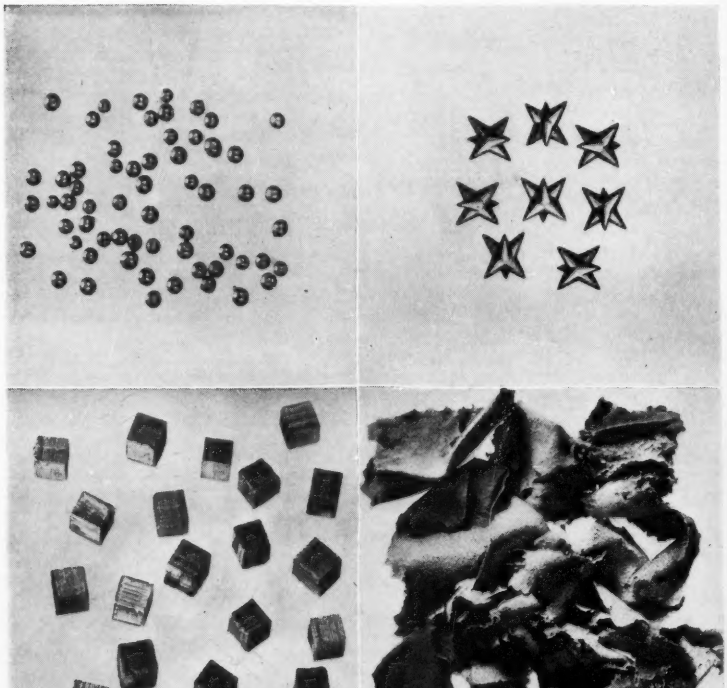

Fig. 3. (Top, left) bright steel shot; (top, right) rumbling stars; (bottom, left) wooden cubes; (bottom, right) leather mousings

TABLE 1

MEDIA AND OPERATING TIMES FOR DEBURRING

Metal	*Form*	*Medium*	*Size (in.)*	*Compound*	*Time (hours)*	*Finish*
Aluminium	Stampings, Turnings	Alundum, Stone, Ceramic	¼-¾	Mild cutting	2-6	Light matte
			¼	Non-cutting	1-3	Bright
		Metallic	¼	Mild cutting	2-4	Light matte
Brass-Bronze	Cast	Alundum, Ceramic	½-1	Rough cutting	20-30	Matte
Brass	Stampings, Turnings	Non-metallic	¼-½	Mild cutting	1-3	Light matte
			¼	Non-cutting	1-5	Bright
		Metallic	¼	Mild cutting	1-3	Light matte
Steel (soft)	Stampings (heavy burr)	Non-metallic	½-1	Rough cutting	10-30	Matte
Steel (soft)	Stampings, Turnings (light burr)	Alundum, Stone, Ceramic	¼-½	Non-cutting	1-5	Bright
		Metallic	⅛-⅜	Mild cutting	1-3	Light matte
Steel (hardened)	Deburred before hardening	Metallic	⅛-¼	Fine cutting	3-6	Brilliant
Zinc-base (heavy burrs)	Casting	Alundum, Stone, Ceramic	½-¾	Mild cutting	3-10	Matte
Zinc-base (light burrs)	Casting	Alundum	¼	Non-cutting	1-2	Bright
		Metallic	¼	Fine cutting	1-4	Moderately bright

Courtesy of Metal Industry, 2nd March, 1951.

prevent clogging and staining and, as previously stated, lubricate. The viscosity of these solutions will, of course, depend upon the size of the components being processed. The heavier the piece the more viscous the solution; this also applies to parts possessing patterns, threads, etc.

These liquids are preferred in the shape of emulsions and are again varied and many, i.e., weak alkaline/water solutions, soap solutions, water. If alkalies are to be used for barrelling of aluminium the *p*H must be kept below 8.

Factors to be Considered

The following factors should be taken into consideration before any job is attempted:

1. Size of burr.
2. Type of metal and hardness.
3. Size and shape of parts.
4. Finish required.
5. Quantity to be processed.
6. Tumbling equipment.
7. Type and amount of compound.
8. Type of abrasive.
9. Barrel speed.
10. Ratio of work to abrasive.
11. Whether tumbling is to be done wet or dry.

(Dry tumbling has a wide range of applicability from heavy castings to finishing operations.)

As previously stated, the burr if of large proportions should be partly removed prior to burnishing. The type of metal and hardness can be assessed by consulting Table 1. The shape and size of parts and correct tumbling procedure must be determined from a trial run.

For finish required. (See Table 1.)

The quantity to be processed will, of course, have a direct bearing on the costs. The type of equipment, amount and type of compound and carrier. (See Table 1.)

Ratio of work to abrasive determined by a trial run, likewise whether tumbling wet or dry.

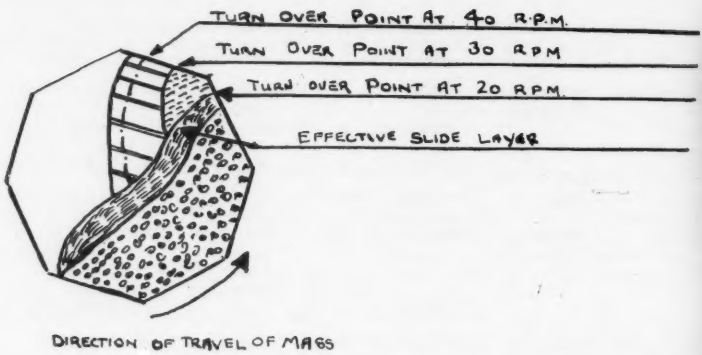
TURN OVER POINT AT 40 R.P.M.
TURN OVER POINT AT 30 R.P.M.
TURN OVER POINT AT 20 R.P.M.
EFFECTIVE SLIDE LAYER
DIRECTION OF TRAVEL OF MASS

Fig. 4. End view of 30 in. barrel. High speeds raise turn over point which drops parts often causing damage. Sliding layer where most work is accomplished, so at 50 per cent. pull more action is obtained because of greater diameter and length of slide

One of the most important factors in barrelling is that of ratio of load, to media and carrier, and the height of the load in the barrel. In barrelling the finishing action consists of a rotary movement of the mass of media and parts to the point where the effect of gravity overcomes the tendency of the mass to stick together. This causes the upper layer of the work load to slide, not fall, towards the lower portion of the barrel. It is during this slide that the greater part of the grinding, polishing or burnishing is accomplished. (See Fig. 4.) It is easy to understand that the shorter the slide the less work there will be accomplished, and therefore a barrel 50-75 per cent. full gives the best results. This can be easily seen from experiments carried out in a closed glass jar.

These experiments can prove both interesting and instructive: a screw cap jar and preferably straight, load to at least 50 per cent. capacity, using the same media to be used in the actual operation. Roll the jar along the table for a measured distance of 12-15 in., make observations and vary the speed of rotation, load, and by measuring the distance, the speed of the barrel rotation can be determined.

Speed of rotation is a very important factor and will again depend upon the type of article being processed and upon the diameter of the barrel. It is often a fallacy that the faster the barrel revolves, the greater the amount of work being done. By using the glass jar it will be seen that if the speed is too great the load just

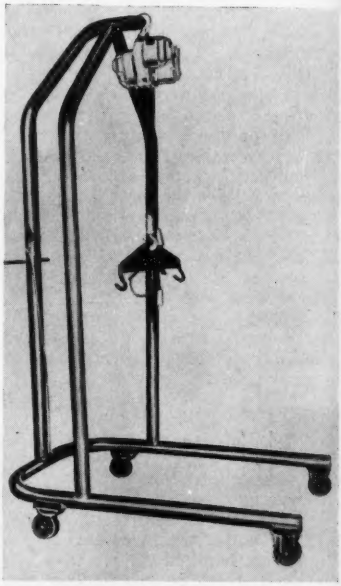

Fig. 5. A self-dumping-hoisting unit

HOT SPRAY PAINTING

How to Control the Finish—from the Start

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The photograph shows a corner of the Demonstration Centre with operators hot-spraying synthetic enamels at the water-washed spray-booth. Three types of paint heaters are shown in the illustration. Take advantage of this "know-how" and let us help you to *control* your finish.

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lifts and drops, and eliminates the work accomplished by the sliding action and leaves the work open to indentation, etc.

Many authorities give definite speeds, but they can be anything from 100 to 1,000 ft. per min., or 5 to 60 rev. per min., and the time required from hours to days, dependent upon many factors.

The loading of the barrel will have a great influence upon the finish, or amount of cut obtained. For roughing the barrel should be half filled with abrasive and the carrier is then added to a depth of 3 in. below the level of the abrasive, the components are now added until the barrel is about 60 per cent. full. The barrel is now ready to run, and assuming that the articles being treated are steel shapes, the speed of rotation should be from 5 to 20 rev. per minute from a 30 in. dia. barrel; the heavier the burr the lower the speed. When these heavy burrs have been smoothed down the speed can be increased.

The reason for the slow speed at the initial stages of the operation is to prevent the hammering over of large burrs, which would happen at higher speeds. Alternatively the barrel may be loaded in layers, i.e., one layer of abrasive, one layer of parts and so on until the barrel is approximately 60 per cent. full.

Finishing in opposition to roughing is different in as much that in the former chemicals and compounds are added which cause the abrasive to burnish rather than to grind the work. After roughing the procedure is to thoroughly wash the work to free it from all abrasive, etc., load the barrel as before with a fine burnishing abrasive then bring the water level up to 5 to 10 in. above the level of the mass, add chemicals as required and rotate the barrel for about an hour at 30 rev. per min.

Unloading should be done carefully; marking can be prevented by using rubber coated screens, etc., for separation of ferrous articles hand magnets can be used. Mechanical separators of the vibrating screen types can be used if the production is sufficient.

Thorough washing is essential, if hot water is available, and it should be done immediately to prevent the well-known troublesome black powder to dry. If this happens it is difficult to remove.

For polishing aluminium steel shot is first used followed by burnishing in hardwood sawdust, and finally by tumbling them in sawdust impregnated with a good grade clean wax.

Auxiliary Equipment

All barrels should be fitted with quick acting locking devices, variable speed and reversible drives, good brakes and safety guards, timing devices and signals. All barrelling shops should possess a hand-operated overhead hoist; the shop should also contain storage bins, ample washing and draining facilities, weighing scales, inspection benches and water and oil tanks.

American manufacturers are paying more attention to barrel finishing technique than their counterparts in Great Britain, and the author outlines one American process. This is known as "Advanced Barrel Finishing" and is marketed under the trade name of "Superscheen." The process uses an octagonal enclosed steel drum, driven by a variable speed drive; predetermined amounts of "Superscheen" abrasives and compounds are loaded with work parts and water or other fluid; loading is achieved by the use of automatic equipment. The "Superscheen" bonded chip is of a special manufacture made up of cutting particles held together with a strong tough bond, and is available in sizes varying from 2 in. by 1-1¼ in. to ⅛ in. by $\frac{1}{16}$ in. Compounds are available for use with various type chips.

A Disc Type Strainer.—Donald Leaver Ltd., 165 Railway Arches, Stamford Brook Station, London, W.6, as selling agents, have sent us details of the Forrest Disc Type Strainer, which is covered by Pinchin Johnson and Associates Ltd. world patents. This machine has been specially designed for the paint industry to strain skins and other extraneous particles from paints, enamels and similar viscous materials. A patented self-cleaning action ensures long runs at high output, and minimises non-productive time for colour or material change over.

LITHOGRAPHIC PRINTING AND DRYING OVEN

RHEEM Lysaght of Bristol have recently installed what is probably one of the largest lithographic printing and drying ovens in the country.

The ordinary drums and pails in general use in industry today are spray painted and will often have a stencilled sign to indicate their contents and place of origin, or alternatively, have a label pasted on.

One of the main objects, therefore, for the installation of this plant is the production of lithographic drums and pails to perform an important customer-relations job, the thought being that customers are bound to be favourably impressed and more strongly sold on a product if it comes to them in an attractive container.

A further reason is that lithographed

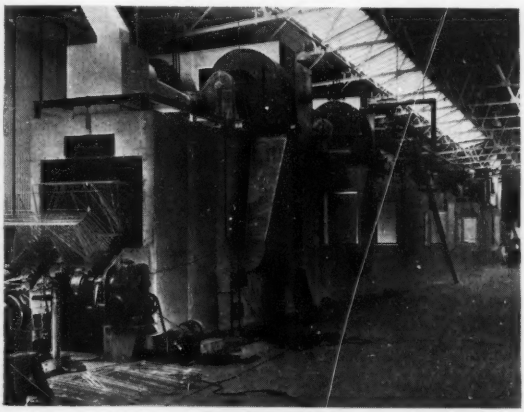

Fig. 1

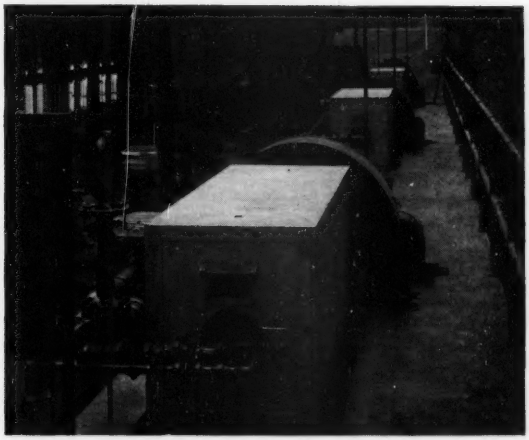

Fig. 2

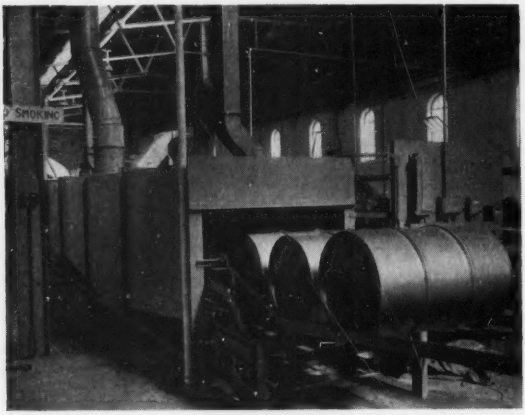

Fig. 3

drums function as a continuous, colourful advertising medium, and as they are moved about from one destination to another they are seen by many people.

The cost of lithographing details of any particular design on the body of a drum is about 1s. per colour more than the cost of a spray painted drum, but the manufacturers feel that this is money well spent because when the drum is in circulation it has real poster advertising value.

The important feature is that all the printing is done on flat sheets and the drums and pails are fabricated afterwards.

A brief description of the process will not, I think, be out of order.

The decorating of sheets for containers and drums is done in approximately the same manner which has been followed for years in the decoration of pails and grease drums. The equipment and handling represent the real changes.

The drum and pail sheets that are to be coated in one colour are run through the coating machine, picked up by wickets on a chain-belt conveyor and passed through the baking oven, which is arranged for direct gas-firing and has a heated section 170 ft. long × 11 ft. high, the overall width of the main chamber being approximately 8 ft. and following the oven section is a cooling section approximately 43 ft. long. A general view of this is shown in Fig. 1.

This oven is flexible to the nth degree. Control ducts and chamber being so arranged that the gases from the hot zone can be transferred to a cooling zone, etc.

Six combustion chambers are mounted on the roof of the casing, generally as shown in Fig. 2.

The two front zones are fitted with large capacity circulating fans, while the remaining four are provided with one circulating fan per combustion chamber, each zone being provided

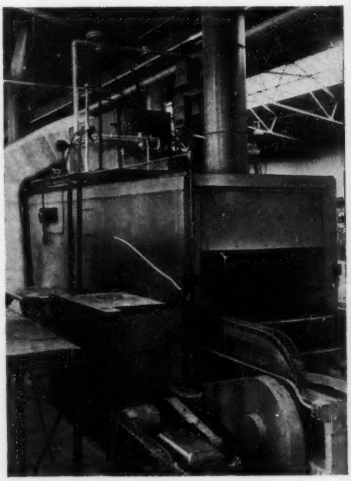

Fig. 4

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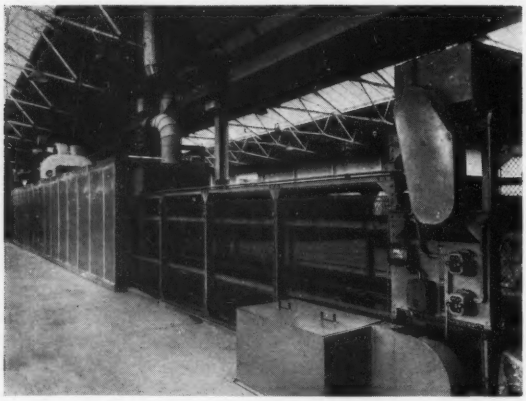

Fig. 5

with its own thermostat control system and each combustion chamber provided with flame failure control and spark ignition.

In the original design trouble was experienced due to the carrier plates being relatively cool when they entered the oven which resulted in unequal drying of the coated sheets. In order to prevent such a condition occurring on the plant under review, bleed connections are taken from the main circulating system in the bottom return section of the oven, this preheats the carriers or wickets before they receive the wet coated sheets.

The following details relating to gas consumption will give you some idea of its size:

At 250° F. the gas consumption is 15,200 c. ft. per hour
At 300° F. the gas consumption is 19,150 c. ft. per hour
At 350° F. the gas consumption is 23,200 c. ft. per hour
At 400° F. the gas consumption is 27,200 c. ft. per hour
At 450° F. the gas consumption is 30,500 c. ft. per hour

This oven has been designed to handle a maximum sheet size 72 in. long, the maximum width of sheet which can be accommodated in the conveyor being 45 in., and the maximum weight of sheet for which the mechanical gear has been designed is 45 lb., and for feeds up to 75 sheets per minute (4,500 sheets per hour).

Each sheet has a 20-min. travel through the oven and when the wickets are lowered some 20 ft. from the discharging end, they are picked up by a belt-conveyor, coated face down and moved to an automatic unloader and stacker where the sheets are stacked on pallets for removal to the production line or storage.

If it is required to decorate sheets with more than one colour these are first run through the coater and oven in the manner explained above, during which they receive their prime or base coat. At the end of the oven, however, there is a star wheel, lowered when not in use, but raised when needed which turns the sheet over so when it gets to the stacker the sheets are stacked with the base coating face up instead of down so as to be ready to run through the press for their succeeding colours.

To feed the printing press with sheets, a Dexter Feeder is employed. Automatically operated suction cups pick up one sheet at a time and feed it on to the belt-conveyor which carries it forward to the press.

From this point onwards the plant is a real example of engineering ingenuity and design.

The sheets now printed, are rolled into shape, seams welded, tops and bottoms fixed in and are finally sent forward for test. Even the test bench

is an interesting example of engineering in itself. Here the drums move in an upright position to the mechanism of the tester, which by means of a reciprocating shuttle that moves back and forth in the base of the tester moves the drums into and out of test position. The pressure platen above, automatically descends, seals the drum and builds up air pressure within it. A small stream of water mixed with a soap testing solution is sprayed the entire length of the seam and at the chimes. Air bubbles indicate a leak. A knee button automatically discharges the drum to a gravity conveyor and the shuttle moves in the next drum. Rejected drums are manually discharged through the rear of the testing unit for repair.

Finally, ¼ in. and 2 in. plugs are inserted manually. The drums, after final cleaning and spraying, are ready to be loaded.

The ovens shown in Figs. 1, 2, 3, and 4, were installed by the Stordy Engineering Co. Ltd., Wolverhampton, whilst those on Figs. 5, 6, 7, and 8, were installed by Controlled Heat and Air Ltd., Smethwick.

As may be imagined, an oven and plant of this description can only run economically when dealing with large orders, for small orders an auxiliary plant has been installed, and the gas-fired plant for this purpose consists

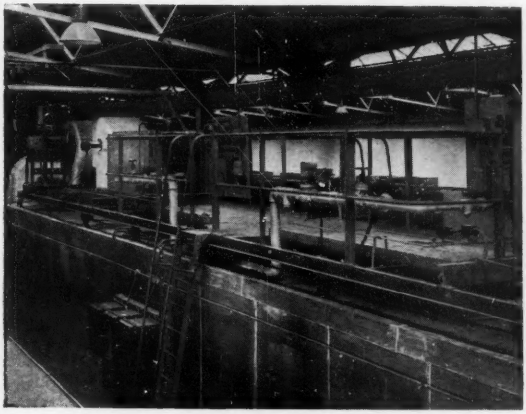

Fig. 6

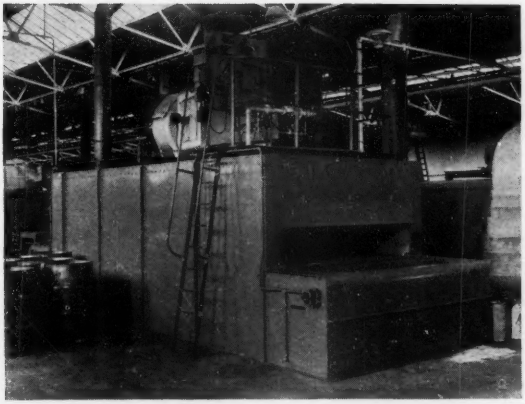

Fig. 7

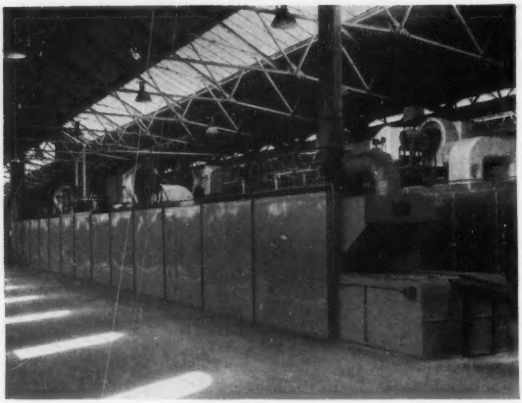

Fig. 8

of a drum washing oven, drum drying oven and drum baking oven, as shown in Figs. 3, 4, 5, and 6.

The normal gas consumption of these ovens is 1,000, 1,500 and 3,500 c. ft. per hour respectively.

For dealing with pails, two additional ovens have been installed, and these are shown in Figs. 7 and 8 and have a normal consumption of 1,200 and 3,000 c. ft. per hour.

An extract from a paper, "Some Aspects of Industrial Gas Application," by T. H. Pardoe, A.Inst.GasE., M.Inst.F., area industrial gas officer, South-Western Gas Board, presented to the I.G.E., South-Western Section, on 8th October, 1952.

A THERMAL SENSITIVE ELEMENT

AN interesting form of thermal sensitive element having unusual and valuable characteristics for flame failure protection devices is being developed by The Horstmann Gear Co. Ltd., of Bath.

It is based on the simple principle that if a source of concentrated heat (for instance, a gas flame) is applied to one side of a metal rod, the side being heated expands more than the other side and the rod is caused to bend. Immediately the source of heat is extinguished, the heat rapidly equalises through the rod which then straightens out, without the rod necessarily having cooled. Thus is obtained the very rapid response so lacking in many systems.

It will be appreciated that the amount of bending of the rod is directly proportional to the difference in the temperature of the heated and the unheated sides of the rod. This difference is determined by the rate at which the heat is conducted through the rod. This is so rapid when a solid rod is used that very little differential temperature and, therefore, very little bending can be obtained, certainly not enough to be of much practical use.

In practice, these sensitive units are made from a stout piece of heat-resisting steel tube firmly mounted in a valve block having suitable gas connections.

The sensitive tube is plugged at its outer end, the plug carrying a stiff rod which projects backwards through the sensitive tube into the valve body and is used to operate a simple valve.

The amount of move and the mechanical power available to operate the valve are considerable.

Built into the valve body is a simple burner fed from a separate connection in the valve body and arranged to play on the side of the sensitive tube to operate it, and the same flame can and should also be the constant pilot to ignite the main burners.

Such a unit can be connected in the bleed line of any gas appliance using a relay thermostat system, and will inevitably close the relay within a few seconds if the pilot is extinguished.

The sensitive unit and its associated circuit can, of course, be elaborated to provide full protection to the pilot as well as the main burner supply and to multiple burner tanks each with their own pilots.

This device is simple, mechanically robust, almost indestructible by heat, very fast in response and inexpensive.

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"THIS METHOD IS NOT AN EMPTY THEORY"

THE BASIS OF THE CANNING INDUSTRY

THE credit for the discovery of the principles which are the basis of the canning process belongs to the Frenchman, Nicolas Appert. For the inducement of a prize offered by the French Government, Appert disclosed his methods fully in his book *L'Art de Conserver pendant plusieurs Années toutes les substances animales et végétales*, published at Paris in 1810. An English edition appeared in the following year.

Records at Chalons-sur-Marne show that Nicolas Appert was baptised there on 23rd October, 1752. Not much is known of his early life. His father was a wine merchant and it is not unlikely that young Appert may first have become interested in the preservation of food substances from witnessing the spoilage that was then of common occurrence in many wines. More certainly, he gained experience, when helping in the corking of the wine bottles, that was destined to be of vital importance to him.

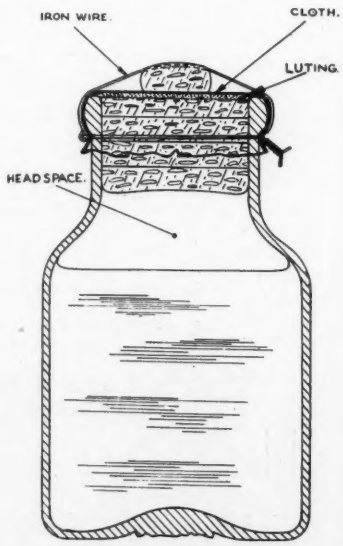
The title-page of Appert's book states that he had been a pupil to the chef of the household of the Royal Duke Christian IV; later he was chef in other houses of the nobility. At the age of 28 he set up in business as a confectioner in the Rue des Lombards at Paris. Soon afterwards, he became imbued with the idea that it must be possible to devise better means of preserving foods than were practised at that time. In fact, the only practicable methods were drying and salting and both these were very damaging to the nutritive qualities of foods.

At that time, half a century before Pasteur's work proved the contrary, it was generally believed by those who had studied the subject that decomposition was a spontaneous process in foods. According to this theory, Appert's researches were foredoomed to failure but his faith that there was a solution to the problem sustained him for twenty years while he devoted his time and savings to his researches.

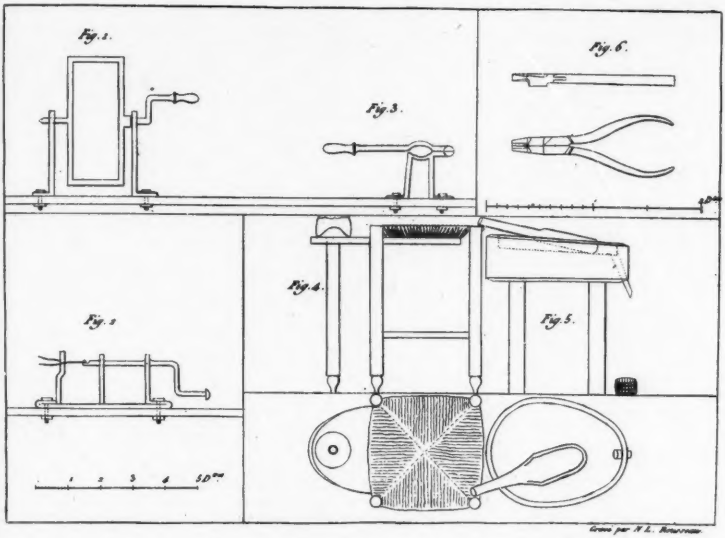
Introducing his discovery, he wrote:

"I shall only observe that as far as my knowledge extends, no author, either ancient or modern, has indicated nor even suspected, the principle which is the basis of the method which I propose.

"This method is not an empty theory; it is the fruit of my dreams,



Appert's wide-mouthed food jar for meat, chicken, etc. (Reconstructed from text details)



The frontispiece to "L'Art de Conserver." Fig. 1. Apparatus for measuring and cutting the wire. Fig. 2. Machine for twisting the wire. Fig. 3. Instrument for compressing the corks. Fig. 4. A stool stuffed with straw, furnished with a wooden stand on which the bottles may be placed to be tied. Fig. 5. A bottle-boot (Casse-Bouteille), within which the bottles are set to be corked, together with a bat for beating in the corks. Fig. 6. Pincers for wiring on the corks

of my meditations, of researches and numerous experiments of which the results for more than ten years have produced such astonishment that in spite of the evidence accumulated by repeated experience, of foodstuffs preserved two, three and six years, many people still do not believe it.

"Before I go into details of my process I ought to say that it consists principally:

1. In enclosing in bottles or jars the substances which it is desired to preserve.
2. In corking the different vessels with the utmost care, for it is mainly on the corking operation that success depends.
3. In submitting these substances, sealed in this way, to the action of boiling water in a bain-marie for more or less time, according to their nature, in the way which I shall describe for each kind of foodstuff.
4. In removing the bottles from the bain-marie at the prescribed time."

Appert's Factory

Appert, with financial help, opened the world's first preserved food factory at Massy (Seine et Oise) in 1804 with about fifty workpeople.

"Description of the workshops that I have set up for large scale production of my process.

"My laboratory consists of four workshops. The first is equipped as a kitchen with stoves and apparatus necessary for preparing all the animal substances which are to be preserved . . .

"The second room is for preparing milk, cream and skimmed milk.

"The third room is for corking and tying the bottles and jars and putting them in bags.

"The fourth room is equipped with three large copper boilers set over the stoves in brickwork. The boilers are each provided with a strong lid which exactly fits the

interior and rests upon the jars. Each boiler has a wide tap below to let out the water at the right time. These boilers hold all the articles to be preserved so as to apply heat to them conveniently in the water bath.

"Beside the above laboratory thus equipped, I have set up three workshops; the first, for preparing vegetables . . . the second, a fruit storeroom . . . the third is a cellar fitted with racks for storing bottles and jars.

"I take care to keep clean the bottles and jars I may need.

"I obtain an assortment of corks, which I soften, and also iron wire, which I cut up. When all has thus been prepared the work is half done."

Sealing

The directions for selecting and preparing the glass jars and bottles and the corks are exhaustively explained, emphasising the extreme importance Appert attached to sealing the containers:

"I chose glass as being the material most impervious to air. I have not risked any test with other materials. I had bottles specially made having bigger mouths with a constriction, that is, with a little flange projecting into the inside of the mouth below the rim, my object being that the stopper should be constricted in the middle . . . (providing) an obstacle to the expansion caused by the application of heat. The Champagne shape (of bottle) is the most suitable; it looks best and it resists better than all the others.

"Too much attention cannot be given to the corks, which ought to be of the finest grade and these are indeed the most economical. My experience has proved this thoroughly, so I use nothing but perfect corks for all my vessels. (For wide jars) . . . I have had to make the corks from three, four or five pieces . . . glued in the right direction, that is, with the pores horizontal."

These built-up corks were dried under compression for a week or two and then cut down to fit the jar. After sealing, the corks and necks were luted with a composition made from lime and milk curd, similar to modern waterproof casein glues. To secure the corks in the jars they were wired down and to increase the compression Appert placed a small disc of cork under the wires:

"By means of the second cork applied in the middle of the big one I am able to make the wire force the cork and give it the proper solidity."

The Process

"When all has been prepared . . . there is nothing more to do than to apply the principle of conservation to the substances. This is the easiest thing to do. I put the vessels or bottles upright in a bain-marie which I then fill with fresh water, so that the vessels are just up to their rims . . . when the bain-marie is boiling, I maintain this degree of heat for more or less time, according to the nature of the objects which are to be conserved. At the appointed time I take away the fire in an extinguisher. A quarter of an hour after, I drain the water off by the tap; half-an-hour later, I uncover the cauldron, but I do not remove the bottles or jars for an hour or two later, and the operation is finished. The next day, or a fortnight later (it matters not) I stack my bottles on racks, like wine, in a temperate shady place. If I am going to send them far away, I am careful to cover them with pitch before putting them on the racks; otherwise this last operation is not essential. I still have some bottles laid under a staircase three years ago, in which the substances have as much flavour as if they had been just prepared, and, nevertheless, they have not been pitched.

"The preserving principle of all food substances is invariable in its effects. The result depends only upon applying it in a proper manner to each substance, according to its kind, with the exclusion of air. This last precaution is of the greatest importance in order to obtain perfect preservation. A sure means of depriving the food substances of contact with air, is to have a thorough knowledge of the bottles and jars that are used, the

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corks and the method of corking."

Appert's concluding observation on his process have been fully justified by events.

"The principle of conservation is invariable, as I have observed it. All the losses I have encountered in my treatments had no other cause than faulty application of the principle, or of forgetfulness or negligence in the preparation, according to my reckoning. It sometimes happens to me that I do not succeed completely in my treatments, but who is the artist who is never mistaken? Can one hope to avoid always a loss that can be caused by a defect either in the jar or in the cork? In truth, however, these cases are extremely rare when one pays attention."

Early Testimonials

The earliest testimonial quoted in Appert's book is dated 14th April, 1807 and was the report of a committee nominated by the Maritime prefect at the naval port of Brest:

"It is shown by what has just been said, that all the foodstuffs, eighteen in number, which were embarked on 2nd December, 1806 and disembarked on 13th April, 1807 and which were examined by this commission, under the presidency of the Commissary of Marine Hospitals, underwent no change during their stay on board and their condition is the same as when they were examined at the beginning of December last."

A similar committee at Bordeaux reported in the same month . . .

". . . the objects prepared by Monsieur Appert . . . were in a state of perfect preservation."

Another testimonial quoted by Appert is dated 7th March, 1807 and was from Rear-Admiral Allemand who wrote to him:

". . . the Captains . . . tasted the vegetables of all varieties which I bought from you fourteen months ago and a case of which my maître d'hôtel had forgotten in a storeroom. As green peas and beans are just beginning to be gathered, the officers thought they were fresh they were so well preserved. They want to buy from you a large quantity . . . I shall also take a considerable quantity."

This document establishes that Appert had supplied samples as early as January 1806, yet four years passed before the Minister of the Interior, Le Comte Montalivet, notified Appert of the award of the prize of 12,000 francs for his invention.

Appert, in his preface, gratefully acknowledged the Minister's encouragement and concluded:

". . . but the most flattering reward that he could give me is the invitation to make public by printing, the knowledge of my processes, because my invention can be of the greatest use in sea voyages, in hospitals and in the home."

It might be supposed that the granting of the award by the Minister of the Interior and the publication of the testimonials from high officers of the French navy would have established the validity of Appert's process beyond dispute, but it is sad to record that Gay-Lussac, the famous chemist, failed to understand the importance of the invention and belittled it.

"Some men who are very enlightened, but perhaps too bound by custom and prejudice, have pronounced against my method, alleging its impossibility."

This might not have mattered but for the misfortune that befell Appert in the war during 1814, when his factory at Massy was wrecked. Because of the prejudice fostered by Gay-Lussac the loans for rebuilding fell through and Appert was forced to sell the property. By the following year, however, he was in production again in Paris and for the first time used tinplate cans, an English innovation of 1811.* It is said, too, that he was experimenting with autoclaves in order to reduce processing times. In the next few years he appears to have become impoverished and eventually he was granted a small pension by the government. Appert died on 1st June, 1840.

(The above is published with acknowledgment to "Tin and Its Uses" No. 27, a periodical review issued by The Tin Research Institute.)

* See *Historic Tinned Foods, T.R.I.Publ.85.*

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CHEM-DRY PROCESS

A NEW technique for rapidly drying protective and decorative coatings of ink, paint, or varnish, has recently been developed by The Meyercord Company of Chicago, Illinois, U.S.A. It is called the "Chem-Dry Process" and it is claimed to harden coatings of drying oils and resins in a few seconds without the use of heat. The new process is based on a chemical reaction between the applied coating and sulphur dichloride vapour instead of the conventional polymerization or oxidation.

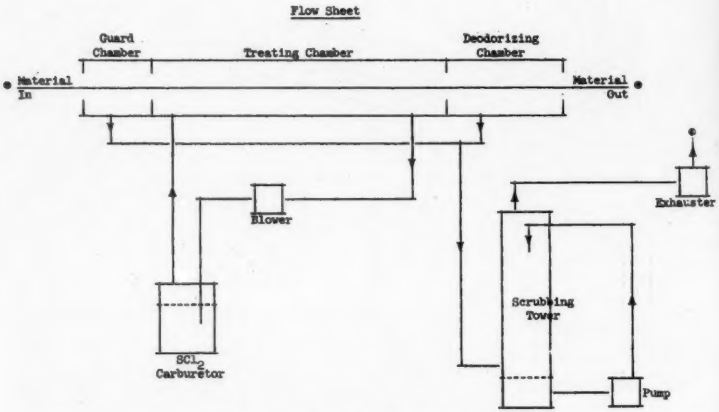
Coated material resulting from printing, roller coating, brushing, spraying, or dipping operations is conveyed into a chamber through which a mixture of sulphur dichloride vapour and air is circulated. The machine for doing the work is constructed in such a way that the vapours adhering to the material are removed, and none of the vapour leaks out into the surrounding air. All air exhausted from the system is scrubbed with dilute caustic soda solution to remove remaining vapour.

The "Chem-Dry Process" is the result of an extensive programme of research and development to perfect a method for hardening heavy ink coatings on paper and efficient apparatus for carrying it out. This included the determination of suitable formulations for inks, paints, and varnishes to be employed so that the colours would not change, and the coatings would dry at the proper speed. Complete machines were constructed and tested under commercial operating conditions. The process gave excellent results except for conditions which required definite control of humidity within the machine.

The process hardens ink and paint by a chemical action which is entirely different from the usual oxidation or polymerization, and the resulting coating has properties which are not the same. In some cases, it may be necessary to modify the formulation of the coating in order to achieve the best results by this technique.

The sulphur dichloride does not merely act as a catalyst, but enters into chemical combination with the film in appreciable amounts.

Thin films of reactive coatings are hardened all of the way through in a few seconds contact time. Thicker



Schematic drawing of "Chem-Dry Process"

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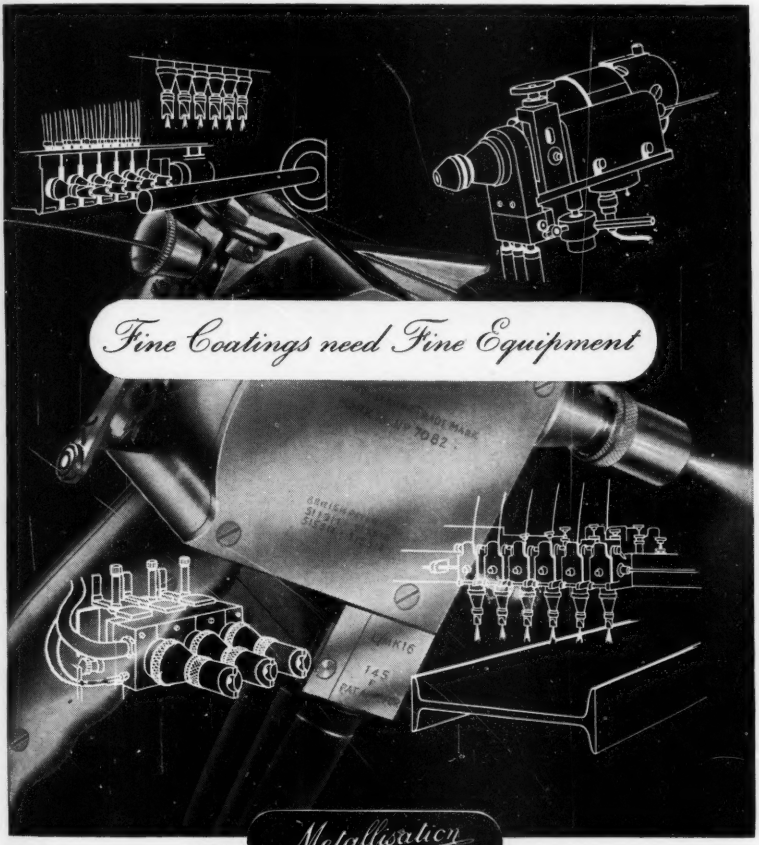
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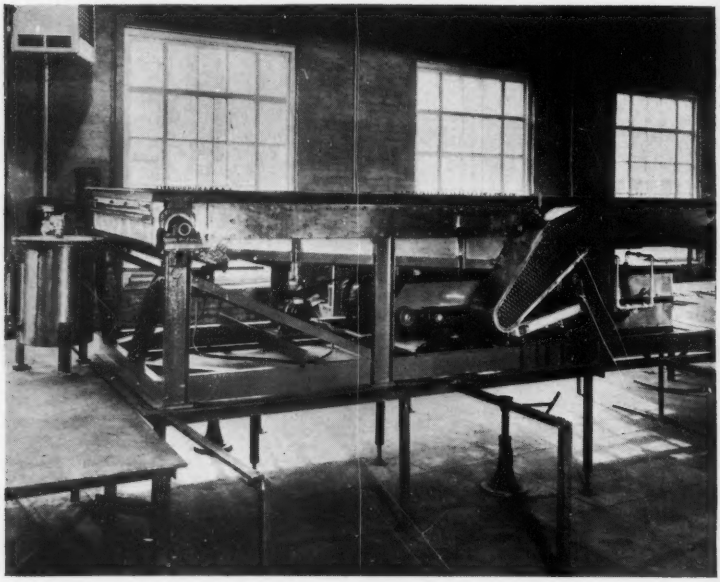

"Chem-Dry" machine

films first acquire a surface dryness and the hardening of the remainder progresses at a slower rate of contact with the sulphur dichloride vapour. There is a sufficient absorption of the vapour in the short contact time to allow a complete hardening of most films.

A very reactive ink applied in a thin film will be sufficiently dry after two or five seconds contact time so that it cannot be smudged even with heavy pressure. A thick film of paint may have a good surface dryness after 10 sec. contact time, but the underpart of the coating may be sufficiently soft so that the film can be displaced easily by a sliding thumb pressure. However, at the end of 30 to 60 min., the hardening may have progressed to the point that the film cannot be displaced and will withstand considerable mechanical handling. The completion of the hardening can take place in the open air or after packaging.

Generally speaking, the "Chem-Dry" technique works well with coatings based on alkyd resins, urea - formaldehyde, melamine - formaldehyde, drying oils, and similar materials. It does not work with lacquers or other coatings which dry by solvent evaporation only. The process is not suitable for use with emulsions or water solutions.

For reactive resins and oils, contact times of from 1 to 20 sec. will give either a complete hardening of the film in the case of thin coatings or a sufficient surface dryness in the case of heavier applications. Somewhat longer contact times may be required for coatings based on semi-drying oils. It is preferable to use the shortest contact time which will achieve the desired results. If 10 or 20 sec. does not give sufficient action, it is best to change the formulation of the coating and employ more reactive materials.

Although the process will harden thick coatings, this action takes considerably longer than the curing of several thin coatings. It is recommended that multiple films which can be hardened all the way through in a few seconds be used to build up the desired thickness. For many applica-

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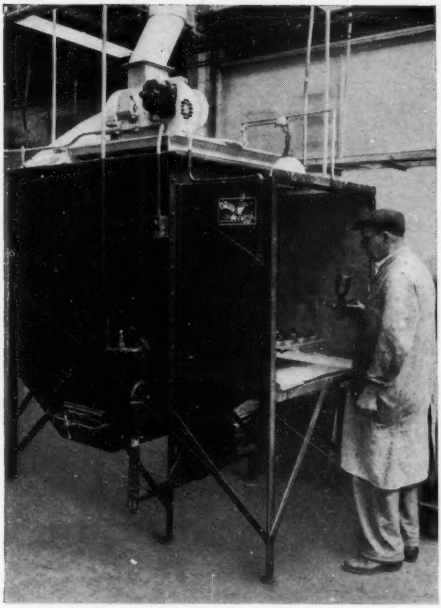

There are no pumps, nozzles or filters to choke or need attention. The only moving part is the fan, which handles the clean dry air from the high efficiency wash and discharges it to the atmosphere.

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tions, a continuous machine can be worked out which will apply coatings one after the other and harden them rapidly with sulphur dichloride.

Solvents do not aid in drying by the "Chem-Dry" method. If a coating contains too much high-volatile solvent, there is a tendency toward blistering. The new method will harden the coatings even though the solvent has not evaporated although the maximum hardness will not be achieved until the solvent has diffused through the film and evaporated. For best results, it is desirable to use as little solvent as possible. Methods of application which permit the use of formulations containing a high amount of solids and a low amount of volatile are preferred. For some coatings it may be desirable to evaporate most of the solvent first and then harden the coating by reaction with sulphur dichloride.

The action of sulphur dichloride is increased by heat and for certain applications requiring extremely fast hardening, it may be desirable to use temperatures in the neighbourhood of 150° to 200° F. For most purposes, however, the reaction is sufficiently fast at room temperature and the installation is simpler because no heat is required.

The new process permits the use of finishes having high durability and pigment content such as those based on alkyd resins and achieves drying times comparable with the high speed lacquers.

The process adapts itself well for quickly coating plastics, wood, and other materials which cannot be baked. A rapidity of hardening equal to or better than commercial baking can be achieved without using elevated temperatures.

The process is especially applicable to coatings which have high percentages of pigment and are therefore somewhat porous. The solvent can escape readily and the sulphur dichloride can act immediately all the way through the film. Fillers such as are used in wood and metal finishing can be hardened very rapidly, and subsequent coats of paints and varnishes may be applied immediately.

I.M.F. ORGANIC FINISHING GROUP

THE Institute of Metal Finishing will be holding the inaugural meeting of the newly formed Organic Finishing Group at the Charing Cross Hotel on Thursday, 19th March, 1953.

The programme for this first meeting includes lunch, inaugural meeting, and two technical papers followed by discussion, with a break for afternoon tea. At the meeting the committee which will be in charge of the Group's activities for the following year will be elected. This committee is to consist of eight officers in addition to the president and honorary secretary of the Institute who will be *ex-officio* members of the committee.

In order to extend the scope of the Group's work nominations to this committee are invited from interested parties who need not, necessarily, be members of the Institute of Metal Finishing but will, of course, be expected to become members in the event of election. Each nominee must be nominated by two persons whose names, business address and status should be given on the nomination form. This form is obtainable from the Head Offices of the Institute, 32 Great Ormond Street, London, W.C.1., and must be returned no later than 1st March.

The meeting will be open to all interested parties, whether I.M.F. members or not, and further details of the authors and subjects of the technical papers will be published in later announcements.

I.M.F. — Sheffield and North-east Branch.—The Annual Dinner and Dance of the Sheffield and North-east Branch of the Institute of Metal Finishing will be held at the Grand Hotel, Sheffield on the 20th February, 1953.

The "Bonderizer."—The Pyrene Co. Ltd., Metal Finishing Division, Great West Road, Brentford, Middlesex, in the January, 1953 issue of the "Bonderizer" give details of the use of their products in connection with the manufacture of Crompton Parkinson fluorescent lighting equipment. Information is also contained on a new fully automatic "Spra-Bonderizing" machine installed in the rebuilt Radford works of the Daimler Co. Ltd., for the treatment of Lanchester car bodies.

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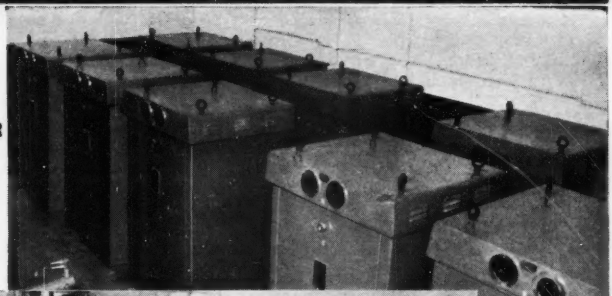

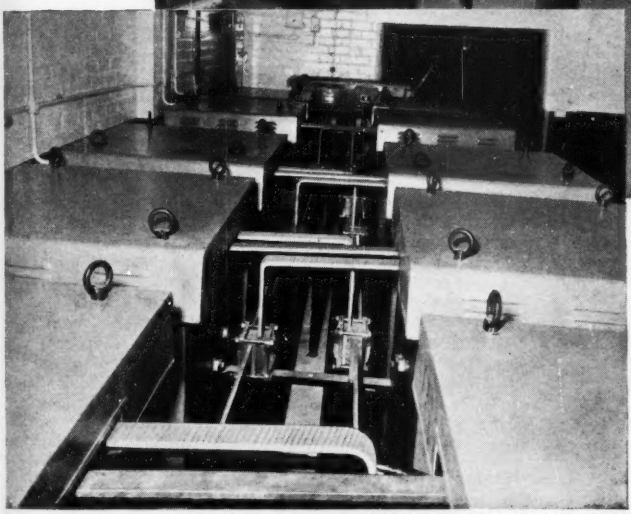

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Recent Developments in the Field of Organic Protective Coatings

(SPECIALLY CONTRIBUTED)

DURING recent years the user of organic finishes has been conscious of a distinct change of fashion in the materials he uses. The most noticeable trend has been away from the older, more familiar materials based on linseed, tung and similar oils as film formers. These earlier coatings are gradually being displaced by the newer synthetic resin-based coatings which include the alkyds, ureas, melamines, chlorinated rubbers, silicones, resins, vinyls and other chemical and abrasion resisting coatings of the baking type.

Hand-in-hand with the development of materials has gone the development in methods of application and the older methods of brush and spray are now being challenged by the newer methods of hot spraying, steam spraying, controlled withdrawal dipping, electrostatic painting and roller coating. The object of this article is to give a short review of the most recent trends and tendencies to enable the finishing shop staff to keep up-to-date on materials and techniques. First let us deal with materials.

Alkyd Resins

This group of resins is probably the best known of the newer film forming materials. They are produced as a result of interaction between a polyhydric alcohol (glycerine) and a polybasic acid (phthalic acid anhydride) and are usually fluxed with a vegetable oil which is a combination of linseed, tung, soya, castor or coconut oil. Sometimes a fatty acid or a fish oil is substituted for the vegetable oil. The alkyds are generally classed as non-drying or air-drying according to the exact make-up. When coconut oil is used the resin is said to be non-drying and is modified with a thermosetting resin (urea formaldehyde or melamine) and heat cured by stoving. This class of alkyd is particularly favoured for white baking enamels as it has the advantage of not going yellow with age as do some of the air-drying types.

For light tints and pastel shades, the soya and dehydrated castor types are usually preferred as they possess a pale colour and, although not so good as the coconut oil type, their non-yellowing properties are quite high. They adhered well to most surfaces and can be supplied by most of the usual methods, brush, dip, spray, etc.

Styrenated Alkyd Resins

This modification of the alkyd resin material permits the production of an alkyd enamel which approximates to cellulose in its drying properties yet retains the advantages of the normal alkyd enamel just described. As is well known, cellulose lacquers dry by evaporation of the solvents from the surface, leaving behind solids; while a paint dries by oxidation and polymerisation of the solids after the volatile matter has left the film. In the case of paints, "drying to touch" occurs anywhere from four to twenty-four hours and driers are usually required to complete the hardening. Styrenated alkyds, however, will dry in little over half-an-hour without the aid of driers, and thus approximate to the advantages of cellulose.

A special advantage of the styrenated alkyd resins is their ability to produce a hammer effect when they are pigmented with aluminium paste or powder. When properly formulated, the enamel can produce polychromatic effects simulating the pattern of hand hammered aluminium in one operation. These finishes are in great demand for such jobs as heaters, car radio cases, vacuum cleaners, and similar products.

Silicone Alkyd Materials

The principal characteristics of silicone resins are outstanding heat stability, excellent weather and

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chemical resistance, gloss and colour retention at temperatures above 400° F. and low temperature flexibility. Enamels based on these resins, particularly those pigmented with aluminium powder, have been very successful when applied to products which became hot in the normal course of events, e.g., metal chimney stacks, exhaust and silencer parts, steam lines, furnace casings, heat exchangers, stoves, etc. When pigmented with other coloured materials they have found wide use in applications such as welding rod identification codes, resistor coatings, radiator coatings, radio valve parts and similar jobs.

Ordinary silicone finishes, however, suffer from some inherent weaknesses which include: poor adhesion to steel, low solvent resistance, thermoplasticity, incompatability with most of the more normal organic film-forming materials and the high temperature needed to cure them. New advances in the field, however, show promise of overcoming these drawbacks. A group of silicone-alkyd resins, for instance, is showing great promise. Films formulated with this material display a heat resistance much higher than any organic film hitherto used. They maintain gloss and the colour remains stable at temperatures up to 400° or 500° F., their hardness and abrasion resistance are equal to the best melamine-alkyd combinations and adhesion and flexibility are as good as any other known organic coating.

New American Development

Properties of these silicone-alkyd coatings place them somewhere in the midway position between vitreous enamel and organic coatings of regular type. In addition to the heat resistance, they can be applied direct on to steel without a primer and, although the initial cost is much higher than vitreous coatings, the ease of application offsets the difference. A new development in America is the development of a baking aluminised alkyd-silicone type of film which is reported as being able to withstand temperatures as high as 1,500° F. If this should turn out to be economically feasible, there is a tremendous market for the material as a coating for stoves, ovens, cylinder heads, kitchen ranges, fires, etc.

Urea-formaldehyde-melamine-alkyd Combinations

Another recent development is the combination of thermosetting type resins such as melamine or urea-formaldehyde, with an alkyd resin. As the thermosetting resins are converted by heat to almost colourless, non-yellowing films, which are extremely hard and brittle, the baked films of these resins alone lack adhesion and are generally brittle. Formulating them with the more elastic film-formers such as the alkyds, ensures excellent adhesion, gloss and abrasion resistance.

The most notable development in this group is the improved urea-formaldehyde and triazine formaldehyde resins used in the U.S.A. for baking finishes on motor-cars, farm machinery, etc. Considerable development has also been made in regard to soap and alkali resistance combined with gloss retention for domestic washing machines, refrigerators, etc.

Fungicidal Varnishes and Lacquers

Designers of electrical and radio equipment particularly, are interested in the latest developments in protection against fungus attack. During the last war the organic materials were often affected when equipment was sent to tropical and sub-tropical destinations. In some cases the plastic insulation and the finishes were affected to such an extent as to render the equipment useless, especially if metallic corrosion was associated with the organic attack. Since so many markets for electrical and radio products are in tropical and semi-tropical locations, this problem of fungicidal protection is of considerable importance to the industrial user and manufacturer as well as to the military user.

Although there is a large range of products and compounds which possess fungicidal properties, practical and technical requirements limit the number which can actually be used in conjunction with paints and lacquers. To be suitable for use in a varnish or lacquer, a fungicidal material must possess the following properties:

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3. Soluble in the volatile component of the varnish or lacquer.
4. Stable when incorporated into the lacquer or varnish.
5. Stable at high temperatures.

The fungicides that have been found useful for fungicidal lacquers and varnishes are in two general classes.

(a) Those depending on metals for their action and (b) those depending on organic radicals and non-metallic elements such as chlorine for their action. The former class is more efficient since the quantity of fungicide needed is less than in the case of the non-metal fungicides. The major drawback in the metal fungicides is the effect they may have on certain electronic components such as unprotected selenium rectifiers.

Tests have shown that combinations of fungicidal agents prove more efficacious than any single fungicide. A combination of 1 per cent. phenyl mercuric ortho benzoic sulphimide and 5 per cent. salicylanilide has been proved to be effective against the fungi which attack electronic equipment.

Along with fungicidal materials and compounds, the finishes will often incorporate materials which increase the moisture resistance of the film thus helping to eliminate the complicating factor of metallic corrosion.

Neoprene Protective Coatings

No review of protective coating materials would be complete without mention of neoprene rubber coatings. Neoprene (polymerised 2-chloro-butadiene) is frequently used for tank and vessel lining, where good resistance to oils and fats is required. Its use was formerly limited by the difficulties of applying it in sheet form. Later, when the material became available in solutions which could be brushed or dipped, the need for oven curing at above room temperature was a handicap that still limited its use. A new solution has now been developed, by the Du Pont Company in America, which can be cured at room temperature, thus opening up new uses for neoprene coatings.

The following details of the new material are based on information supplied by the manufacturers, as no reliable experience of its use in this country can be quoted.

The new neoprene solution, known as type KNR cures at room temperature in 24 to 48 hr. It has the same chemical resistance and practically the same physical properties as the conventional solution, the room temperature curing feature being effected by the addition of a recently developed accelerator. Besides curing at room temperature, type KNR neoprene solution has another desirable characteristic, namely, high solids content with low viscosity.

Ordinary neoprene solutions have a solids content of 35 to 40 per cent. For natural rubber solutions it is even less. The new temperature solutions have a solids content of 60 to 70 per cent. yet are easily brushable. A single dip of brush will give a solid finish film 1/64th in. thick. By repeated coatings, allowing one or two hours drying time between coats, a thickness of $\frac{1}{16}$ in. can be built up. Longer drying periods do not reduce the adhesion of the next coat, good adhesion being obtained in thoroughly cured films.

Room Temperature Curing Solution

The room temperature curing solution is not supplied ready-mixed. The accelerator cannot be added to the neoprene paint at the time of manufacture because it would cause the material to jell in the container. It must, therefore, be added to the paint just prior to its application. It comes as a slurry and mixes readily. The pot-life of the accelerated paint is dependent upon the amount of accelerator added and the ambient temperature at the time the coating is applied. By adjusting the amount of accelerator added, the usable life of the mix may be as much as 24 hr. or longer and the cure of the dry film will still proceed at a satisfactory rate.

Before the addition of the accelerator, the paint has a can stability of a year or longer. One manufacturer of this paint has eliminated the

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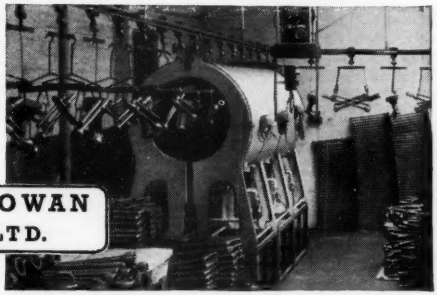

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annoyance of adding the accelerator at the time of application by adding a smaller amount of accelerator at the time of manufacturing the paint. A can stability of six to eight months for the one-part paint is claimed. Of course the time required for curing the dried film is longer.

Although compositions can be made in various colours, more sacrifices in corrosion and abrasion resistance must be made because of the necessity of not using carbon black in the compounding. Carbon black is the most chemically resistant filler used and it also improves the resistance of the material to abrasion.

Accelerated neoprene paint can only be obtained in the darker shades. Light pastel colours are not practical because of the inherent tendency of neoprene to darken on ageing. Some of the suitable colours are red, blue green and brown.

For most maintenance coatings on large storage tanks or process vessels it is customary to apply one coat of chlorinated rubber adhesive primer and two coats of the accelerated neoprene paint. Where extremely corrosive conditions prevail, the neoprene coat can be built up by repeated brushing.

There are two basic fields of application of neoprene coatings—as protective finishes on functional machine parts subject to corrosion and abrasion and as a repairable maintenance coating on large industrial equipment such as tanks, ducts and piping.

Epon Resin Coating Materials

An entirely new class of condensation polymers is now available known as the Epon or Epicote resins. These are prepared from the condensation of bisphenol (prepared from phenol and acetone) and epichlorhydrin. When heat cured, these resins exhibit unusual flexibility, hardness and adhesion but suffer from the slight disadvantage that they have to be cured at a comparatively high temperature (about 215° C.). When cooked into a varnish these "Epons" may be air dried and are then used to a great extent as tough floor varnishes, etc.

The unmodified resins can be formulated with urea-formaldehyde, melamine formaldehyde, and phenolic resins and must then be heat cured. The heat cured films are used in pigmented form for application to metallic products, such as farm implements, for hard service and the clear films are used for food can linings. The excellent chemical resistance of these resins makes them eminently suitable for use in the finishing of dairy and food handling equipment.

Vinyl Resin Coatings

Another trend in the field of organic coatings is the use of special coatings as temporary protective films for delicate metal surfaces such as plated or polished aluminium, the purpose being to protect the surface against abuse or damage during processing. After processing, the coating is stripped off and the true surface exposed; other examples of uses for this type of coating are the masking or stopping-off of parts in a plating vat or the storage and transport protection of spare parts or machine tools.

The vinyl coatings are particularly suitable for these duties. They are thermoplastic, non-oxidising, non-polymerising, non-toxic and odourless. They deposit the film by evaporation of the solvents in a similar manner to the cellulose film-forming materials.

Vinyl resins have been successfully applied by means of solution techniques, as dispersions in organic media or in water. They may be pigmented or plasticised as desired and applied by spraying, dipping or roller coating. For certain applications, a technique has been developed for applying vinyl resins in the form of dispersions known as organosols and plastisols.

For practical purposes the process is called plastisol if less than 5 per cent. of volatile liquids are used, organosol if the amount is greater. Film formers are polymerised vinyl resins such as vinyl chloride and vinyl chloride-acetate. The organosol process permits the use of resins of higher molecular weight than can be normally used in other processes. resulting in films and coatings of added toughness and strength. Organosols are used on cloth, paper, metal foils and dipped goods; plasti-

sols are used for the heavy flexible coatings of tank linings, plating racks and other items.

Chlorinated Rubber Coatings

Chlorinated rubber is a film-forming material which is soluble in such solvents as the aromatic hydrocarbons of the petroleum and coal tar industry; xylene and naphtha being two of the most usual. Chlorinated rubber coatings dry by evaporation of the solvent and this fairly rapid drying characteristic is one of the reasons which makes them so useful in the protection of industrial plant which is exposed to the effects of chemical fumes and yet cannot be put out of use for any considerable period for repainting.

Chlorinated rubber itself when dissolved in solvent and loaded with pigments but not formulated with any modifying agents, is of little commercial value. The chlorinated rubber material must be compounded with resins and plasticisers if it is to have proper adhesion, gloss, flexibility and toughness.

If chlorinated rubber is formulated together with resins which are liable to saponify, such as an alkyd resin, serious weakening and failure of the film may occur on exposure to alkalis and caustic, yet the film will have extremely good resistance to average mild corrosive atmospheres. If resins and plasticisers known to be chemically inert are used, then films may be produced which have extremely good resistance to all types of corrosive influences. Examples of this are the compositions of chlorinated rubber with such materials as the solid types of chlorinated biphenyls, chlorinated paraffins, coumarone-indene resins, etc.

Paints formulated from, and including, chlorinated rubber are known to be among the most practical of the film-forming materials for protection and resistance to acids, alkalis, salts, moisture and fungoid growths. If principles of formulation are used which do not detract from the natural resistance of the rubber, very satisfactory results are obtained.

The foregoing, whilst by no means a complete list of newer developments and trends in organic coatings, is sufficient to bring the modern finish-

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ing shop supervisor up-to-date in his knowledge of the subject. Let us now take a look at the more recent trends and developments in application methods.

Hot Spray Painting

Probably the most notable advance during the last few years has been the increase in the number of installations for hot spray application of paints and lacquers.

Hot spray application finds its best use in the finishing of such products as refrigerators, washing machines, tractor parts, motor-car bodies and similar surfaces where the demand is for a high quality finish with a good proportion of solids coming from the gun in each coat so as to reduce the amount of work and the number of coats needed to produce a satisfactory finish.

The basic principle of hot spray is to reduce the viscosity, and therefore the amount of solvent required, by means of heat instead of by the addition of thinners which are expensive, have to be lost by evaporation and necessitate the use of several coats of lacquer to achieve the required thickness of the final film. Reduction to spraying viscosity is achieved by heating the lacquer to approximately 160° F. Safety precautions are the same as for cold spray lacquer.

Basically, there is no difference in the quality of finish or in composition of solids, between hot-sprayed and cold-sprayed lacquers. However, fast evaporating solvents are almost eliminated. Solids content is increased to 33 per cent. to 35 per cent., in place of the original 10 per cent. which was usual about 1926 and the 20 per cent. which had become normal by 1948. As a result, the number of coats is correspondingly fewer.

For motor-car purposes cold lacquer requires three double coats while hot lacquer gives the same finish in one or two coats. Material and labour costs are correspondingly reduced. In addition, less sanding and polishing are required. These advantages are also obtained with hot spraying of synthetic resin base finishes. Spraying temperature is about 170° F. The paint dries to a better gloss and without runs, sags or "orange peel."

Hot spray equipment is now available from a number of suppliers and the plants are in three main forms: the simple heat exchanger type with no moving parts, the water-jacket transfer type with a circulating pump for the lacquer and the direct immersion heated container type, again with pump-assisted circulation for the lacquer. In the U.S.A. a simple electrically heated cup is available for use with the ordinary spraygun but this has not, so far, come on to the British market. With most of these equipments the lacquer is brought up to working temperature in about 15 min. and afterwards control is automatic.

Steam Spraying

Similar in principle to hot spray plant is the steam spraying equipment which was described in detail in our August issue. For the purpose of this article we give a brief résumé of its main points. The method requires completely new equipment including a new spraygun using superheated steam at 60 to 100 pounds per sq. in. in place of the customary compressed air supply.

The use of superheated steam as an atomising medium serves to heat the finishing material, in similar manner to hot spray methods, thus lowering the viscosity and enabling heavier coats to be applied with less risk of sagging and running. Savings in solvents and thinners are similar to those of hot spray and the same principles and limitations apply. The method seems to hold out hope of reducing application costs where the steam plant only can be used without the need for an additional compressed air installation.

Controlled Withdrawal Dipping

While the practice of dipping articles to obtain a paint film on them has been practised for about a hundred years, it is only in recent years that any attempt has been made to put the process on a scientific basis. The technical difficulties in all dipping processes are not in the dipping but in the withdrawal of the product from the paint container.

The two factors which simply must be studied in planning a paint dipping

job are the formulation of the paint and the rate of withdrawal. Modern equipment for paint dipping is available from a few specialist firms who have made a study of the peculiar requirements of the process. The machines fall into two distinct categories: (a) those in which the work is loaded on to a frame and the frame is lowered and raised from the paint container and (b) those in which the workpieces are held in a jig while the paint container rises up to immerse them, and then recedes at a controlled speed.

In both cases the sequence is the same; quick immersion, dwell for the paint to soak in to the surface and withdrawal at a speed which suits the characteristics of both paint and workpiece. The control of withdrawal is effected in various ways according to the make of machine. Some use a counter-balance weight and hand control, some use a dashpot and valve mechanism and some use hydraulic cylinders and an oil pump, the output of which and, therefore, the speed of pumping, is controlled by a handwheel or valve.

In many cases a bead or droplet of paint will form on the lowermost edge of the work as it leaves the paint. The removal of this is usually effected by a touch with a brush as it completes draining. Alternatively it can be removed by electrostatic means. Much has been written on the subject of electrostatic detearing and a good point to bear in mind in this connection is that an astronomical number of blobs of paint can be removed by a touch of the brush for the cost of the electrostatic plant. True it is not so spectacular but it is cheap and quite effective.

Electrostatic Painting

As this method of painting has been so much publicised of late there will be few readers who will not be familiar with its principles. The latest development in the field, however, is the dropping of the spraygun and the substitution of the special cup-shaped atomising sprayheads. These are in the form of a hollow cone and the coating material is now metered at a predetermined rate to the apex of the head, from there it is spread evenly over the inner surface by rotating the head. This permits an even flow to the outer edge and a thin film of paint thus covers the inner face of the cone. Then, as the paint is attracted off to the product by the electrostatic effect, more material feeds in from the source of supply. As no compressed air is used there is no atomising problem and variables normally associated with spraygun techniques are absent. An efficiency of 99 per cent. is claimed and it is said that, if a small product follows a larger one on the conveyor the cone spray can actually be seen to tighten to conform to the reduced area of attraction.

Roller Coating

This method of applying finishes is not very much used in this country but has a fairly wide application in the U.S.A. As the term implies, it consists of coating metal or non-metal stock by transference of paint from a series of rollers. The average coverage by the process is at least 50 per cent. greater than brush or spray.

The film thickness that can be applied is controlled by the adjustment of the rollers; the speed at which stock can be coated depends only on the speed with which the coated stock can be removed and the drying time of the coating material. Practically any type of stock can be coated one or both sides as well as on the edges, and the material can often be coiled as it comes from the machine by incorporating an infra-red drying stage in the outlet.

When sheets of less than $\frac{1}{16}$ in. thickness are being coated, it will be obvious that the coating roller will come into contact with the support roller every time a sheet leaves the machine and this, on a one side only job, would mar the reverse side of the work. To overcome this a steel knife is arranged on most machines to scrape against the chromium plated surface of the lower roller and remove any surplus material.

Machines are made for coating both sides of a sheet but, owing to the fact that the sheet is then wet on both sides and difficult to handle, this type of coating is limited to work that can be supported by the edges for drying.

SOME FACTORS IN SPRAY SILVERING*

by

P. B. G. UPTON, G. W. SOUNDY, and G. E. BUSBY

IN recent years metallising processes involving the chemical reduction of aqueous solutions of metallic salts have come into considerably greater prominence than formerly. The demands of the wide variety of applications in which such processes now figure have resulted in the development of the so-called spray-silvering technique where separate sprays of silver solution and reducing solution from a special gun are combined and the mixed spray directed on to the surface to be silvered. A number of these processes are now in fairly wide use and were referred to in an earlier publication by one of the present authors. The present publication refers to a particular process developed for use in electrotyping and employing a solution of formaldehyde for the reduction of silver ammonionitrate solution; most spray-silvering processes are, however, basically similar and it is probable that similar considerations will be applicable to all.

* *J. Electrodepositors' Tech. Soc.*, 1952, **28**, 103—113.

Description of Process

(1) *Treatment of the surface before silvering*

Treatment of a glass surface before silvering with a stannous chloride solution has been shown by a number of authors to increase the initial rate of formation of a subsequently deposited silver mirror. Banks and Upton found that this effect was due to the deposition of a film of a basic stannous compound (e.g., hydroxide or basic chloride) on the surface and further that a hydrophilic film having appropriate reducing properties could be produced on a hydrophobic surface by immersing it for a few seconds in a stannous chloride solution containing an anionic detergent. With this development it became immediately practicable to silver a much greater variety of materials and a "sensitising" solution of this

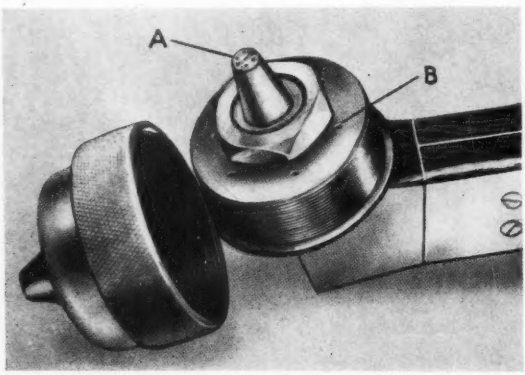
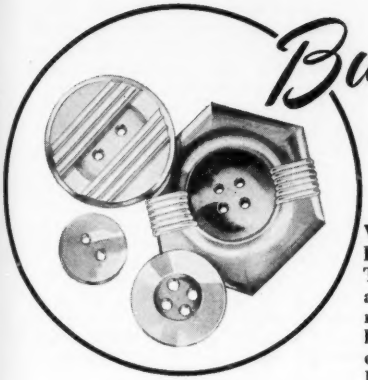


Fig. 1. Nozzle of spray gun



Buttons and Paint?

Whatever the product there's a specialised Kearsley Industrial Finish fit for the purpose. These specialised finishes, formulated, tested and produced to suit individual requirements, can be relied upon for consistently high performance under actual working conditions — on their reputation alone Kearsley Industrial Finishes are used and specified in all walks of Industry.

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type was used in the present work.

(2) *Silvering*

Silvering was effected by directing a mixed spray of formaldehyde and silver ammonionitrate solutions on to the previously sensitised and washed surface by means of a suitably designed spray gun. The spraying head of the gun is shown in Fig. 1. The spray gun consists essentially of a single nozzle, made in stainless steel, through which pass a number of channels. The ends of these channels can be seen as six holes arranged symmetrically around a central hole (A in Fig. 1). Fig 2 shows the complete gun (prototype model) in which the nozzle is covered with a cowl. By means of channels through the handle of the gun the two solutions are led separately to the nozzle tubes from which they emerge separately from alternate holes. Compressed air is fed into the space between the cowl and the nozzle through the large holes (B in Fig. 1) surrounding the base of the conical nozzle. The solutions are thus impelled forward in fine sprays which eventually mix some distance from the nozzle. The central hole in the cone also discharges air and this assists in intermingling the liquid sprays. Approximately suitable con-

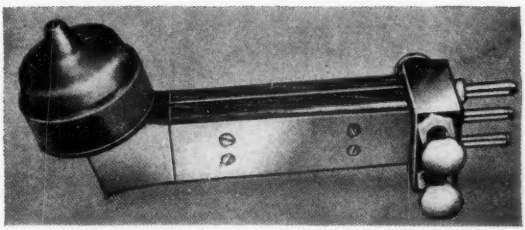

Fig. 2. Complete spray gun—prototype model

centrations for the silvering solutions and the supply of reactants to the gun were first determined using the method of Fizeau as quoted by Hepburn for rough estimation of the amounts of silver deposited and having regard to the character of the silver deposit and the need to silver an electrotype mould in as short a time as might be reasonably convenient. In this way provisional concentrations for the solutions were fixed at 2 per cent. silver nitrate (i.e., 2·4 per cent. silver ammonionitrate) and 3 per cent. formaldehyde with a supply of equal volumes of each solution to the gun. This concentration of formaldehyde is more than sufficient to reduce all the silver salt in the silver ammonionitrate solution but it was obviously preferable to increase the speed of reaction by increasing formaldehyde concentration rather than silver in view of the comparative cheapness of the former. The use of a higher ratio of formaldehyde to silver gave somewhat dark discoloured silver deposits. The three solutions used were therefore as follows:

Solution (1) (*"Sensitiser"*)

Approximately 4·8 per cent. of stannous chloride in 3·5 per cent. hydrochloric acid (just sufficient to prevent hydrolysis of the stannous chloride) and containing 1 per cent. of Perminal WA or 0·4 of Perminal BX. Perminal is a commercial (Imperial Chemical Industries) preparation of a sodium alkyl naphthalene sulphonate, WA being a standardised preparation with an inert diluent. The solution was prepared by dissolving 120 gm. of stannous chloride dihydrate in 100 ml. of concentrated hydrochloric acid, warming if necessary to obtain a clear solution, diluting to 2¼ litres and adding 250 ml. of 4 per cent. Perminal BX solution.

Solution (2)—*Silver solution*

2·4 per cent. silver ammonionitrate prepared by dissolving 50 gm. of silver nitrate in about 2 litres of water adding ammonia solution till the initial precipitate just re-dissolves and making up to 2½ litres with water. In order to avoid the possible danger of forming explosive silver nitride it is important to ensure that (1) all the silver nitrate is dissolved before adding ammonia, and (2) that ammonia is not added to a concentrated (>4 per cent.) silver nitrate solution.

Solution (3)—*Reducing Agent*

Three per cent. formaldehyde solution prepared by diluting 185 ml. of formalin (40 per cent. formaldehyde) to 2½ litres.

The pressure of the air feed to the gun was fixed at 24 p.s.i. giving an air flow of 10 cu. ft. per minute of free air, this air pressure being the minimum needed to give a continuous finely divided spray. A measured spraying distance (i.e., the distance from nozzle-tip to plate) was used in each experiment.

With these provisional arrangements the authors then discussed quantitative effects including growth of silver film with time, effect of rate of flow of solutions, effect of spraying distance, effect of concentration, and qualitative effects including addition agents and contaminants.

Applications

On the question of applications the authors state:

The prime reason for the development of this process was the need to apply an electrically conducting layer to the moulded matrix (wax or plastic) used in reproducing type or half-tone originals in electrotyping, and this silvering process has now become very general practice in that application. However, there are obvious possibilities in other directions and in fact appreciable applications have been found outside the printing industry, notably in the allied field of electroforming, and to some extent in the decorative metallising of plastics. In the former case the process has encouraged the use of electroforming in producing many precision components which would be certainly expensive and in many cases difficult or even impossible to produce by normal engineering techniques. We feel that this is a field with great possibilities which is likely to see considerable expansion in the future.

One difficulty with decorative silvering produced by this method is that in most cases the silver film must be protected from abrasion and

tarnishing on handling, and except for occasional cases where it has been possible to use the obverse of a silvered transparent plastic component as the working surface, a lacquer has had to be applied. This lacquering invariably tends to produce some yellowing of the reflected light (excellent gilt effects can in fact be readily obtained) and it has not been found possible to preserve entirely the whiteness of the silver. That the yellowing appears to be an optical effect—presumably due to the silver particles remaining of colloidal size—has been demonstrated by buffing the silver film before lacquering with a soft rotary mop; when the silver is afterwards lacquered the defect does not arise. Incidentally an interesting plate silver type of finish can be readily achieved by buffing a fairly thick sprayed silver deposit and no difficulty arises if the deposit is initially adherent (cellulose acetate is a good basis material in this case).

The use of the "sprayed" silver deposit as the basis for decorative electroplating on plastics is of course obvious, and the process has been used for this purpose.

Conclusions

The conclusions drawn by the authors are that whilst, owing to pressure of other work, it has not been possible to carry this study as far as might be thought desirable, it is felt that this limited work is sufficient to show that spray silvering can be a valuable and economical additional tool in the field of coating with metals in its extension to deposition on electrically non-conducting base materials. It is to be hoped that this limited study will in due course be extended to a full understanding of the process.

Acknowledgments are made to the Council of the Printing, Packaging and Allied Trades Research Association for permission to publish this work.

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AGRICULTURAL FINISHES

Jimmy Edwards, the comedian, visited the stand of Robt. Ingham Clark and Co. at the recent Smithfield Show. He is seen here with Mr. G. F. Ingham Clark, general manager, and members of the staff

Electro-finishing of Metals

AT a joint meeting of the London and South-Eastern Counties Section of the Royal Institute of Chemistry, and the Sir John Cass Chemical Society, held recently at Sir John Cass College, with Dr. C. W. Herd in the chair, Dr. S. Wernick, F.I.M., F.R.I.C., gave a lecture under the above title.

Electroplating for decorative and protective purposes is the widest application of electro-finishing of metals. It was first carried out with carbon-zinc batteries in printing processes, and the methods have developed, with the help of the dynamo and the rectifier, until plating with chromium, tin, cadmium, zinc, silver, copper and copper/zinc and nickel/cobalt alloys, together with many other metals for more specialised purposes, is extensively carried out today.

The surface of the base metal should be treated by degreasing and by removal of any layer of strained metal, since the crystal structure of the base metal can be continued into the plating. A thin deposit will exhibit porosity, which becomes less as the coating increases in thickness. A well-deposited layer of nickel or tin of 1-2 thousandths-of-an-inch in thickness should be free from porosity. If the protective metal is electropositive to the base metal, corrosion may be accelerated if both are exposed.

When the plating bath has small "throwing power," recesses in the article may not be effectively plated. To some extent this can be overcome by specially shaped anodes, by the use of auxiliary anodes, or by insulated screens to prevent over deposition on raised areas.

Building-up Worn Parts

Building up worn or badly-machined parts by electrodeposition permits the salvage of components which would otherwise be scrapped. Chromium is particularly useful, due to the formation of a maze of fine cracks which retain lubricant. Subsequent heat treatment is sometimes necessary since the deposition may cause embrittlement of the base metal.

Electro-forming is used for the reproduction of very fine detail, as in electrotyping and the manufacture of gramophone records.

The lecture was illustrated by slides showing the crystal structure of various deposits and various features of large-scale electrodeposition, and was followed by an interesting discussion.

Replying to the Chairman, Dr. Wernick gave several examples of the deposition of alloys and mentioned some of the factors affecting the throwing power of a bath. Dr. Griffiths was told that a bath of good throwing power was one which gave a uniform deposit at all locations. Although attempts had been made to define throwing power quantitatively, none were quite satisfactory. In general, dilute solutions and large distances favoured uniformity of deposit. Mr. Spencer suggested that the presence of the metal in the bath as a complex might favour uniform deposit, and Dr. Wernick agreed, pointing out that any attempts to speed up rate of deposition affect the uniformity of deposit adversely.

Mr. Westwood enquired about the ratio of sulphuric to chromic acids needed for chromium deposition. Dr. Wernick replied that although a ratio of one to 75 or 100 was critical, the exact function was unknown, and added, in response to another question, that chromium deposited on aluminium had poor adhesion. Mr. Nyman was told that stresses in the base metal were not necessarily continued into the plating; they were often due to the occlusion of hydrogen. Mr. Martin asked about the composition of a bright nickel plating bath. Dr. Wernick replied that bright nickel deposits were achieved by the addition of either cobalt salts to the bath, or small quantities of organic material.

Mr. Tucker was given an account of the principles of anodic electropolishing.

Mr. Spencer proposed a vote of thanks to Dr. Wernick. In his reply, Dr. Wernick stressed the opportunities for chemists in the field of electrodeposition. Dr. Herd thanked the authorities of Sir John Cass College, and Dr Ward replied.

E.C.C. News.—We have received the Works Institute Journal of The Electric Construction Co. Ltd., Wolverhampton, covering the Winter 1952 quarter, which contains an abundance of items concerning the social activities of the Company and under the title "Industries We Serve" discusses the making of boots and shoes.

Compressed Air Equipment.—We have received from B.E.N. Patents Ltd., High Wycombe, Bucks, a copy of their leaflet C.B.101 which gives details of a comprehensive range of air compressors, spray painting plant and spray guns together with various accessories.

FUEL ECONOMIST

EDITORIAL DIRECTOR: W. F. Coxon, M.Sc., Ph.D., F.R.I.C., F.I.M., M.Inst.F.

fortnightly

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ABRASION AND ACID RESISTANCE OF VITREOUS ENAMELS

A REPORT has reached us of the work done by the Enamelled Metals Laboratory of the American National Bureau of Standards on behalf of American enamel manufacturers. It reveals interesting effects of acid pretreatment of vitreous enamels on the acid resistance and abrasion resistance of the treated specimens. Although, say the Bureau, work is still proceeding, the results to date are sufficiently interesting to merit publication.

During revision of a specification, some tests were made with the object of comparing the relative effects of hydrochloric, citric and acetic acids on a range of enamels. Results showed that acetic acid (vinegar) is much less corrosive than citric or hydrochloric. A remarkable discovery, however, was that the comparatively minor visible attack of acetic acid strongly inhibited further attack when subsequently treated with citric acid, although the citric acid severely attacked untreated sections of the test specimen.

Pretreatment with acetic acid, in concentrations from 0·5 per cent. to 50 per cent., for periods of 5 min. and upwards were sufficient to protect against subsequent treatment with even 10 per cent. citric acid. Treatment with butyric acid for 15 min. had the same effect, but neither tartaric nor lactic acids were effective. A possible explanation put forward is that acetic and butyric acids both have the ability to preferentially leach alkalies from enamel surfaces leaving behind a silica-rich film which is resistant to further solution even in citric or stronger acids. With citric acid, the attack seems to go to a greater depth before build-up of this film is sufficient to inhibit further solution.

Abrasion Resistance

During the course of these experiments it was found that pretreatment for 15 min. in 10 per cent. citric acid markedly lowered the abrasion resistance of certain enamels having the Class A and B grade acid resistance as graded by the American Porcelain Enamel Institute's standard test. Moreover, on titanium-type enamels the effects were much more pronounced than on the antimony-type enamels. In neither case was the resistance to abrasion of Class AA enamels affected.

The effect of abrasion, to an extent comparable with that used when a stained spot is scoured, was sufficient to reduce the abrasion resistance rating from a good Class B to a poor Class C by the same test, modified to include the abrasion treatment. An equal amount of abrasion showed no visible effect on the untreated areas of the same specimen.

The researchers believe that these two effects are interrelated and that the silica-rich layer which results from preferential leaching of the alkali is less able to withstand abrasion than the original surface, in spite of the fact that it is more resistant to acid attack.

An inference to be drawn from the foregoing tests and results is that titanium-type enamels are specially sensitive to the above effects and, therefore, regular tests should be instituted in factories handling these enamels to ensure that the processing is carried out at optimum conditions. Additionally, the results would seem to indicate that it is desirable to include an abrasion test in the standard series of tests for regular productions of titanium-type enamel products.

MOULDED FLOW CUPS

RECENT interest in the trade has centred on the variations in viscosity to be observed when using No. 4 Ford Cups from different suppliers. Attention has been drawn to B.S. 1733:1951, Flow Cups and their Method of Use, in which the type B cup is based on the dimensions of the No. 4 Ford cup and is suitable for consistency measurements in the range, 0·5-3·0 strokes.

Resinous Chemicals Ltd., manufacturers of synthetic resins and moulding powders, now announce the production of a plastic Ford cup which conforms to B.S. 1733 and has an orifice of diameter $0{\cdot}156 \pm 0{\cdot}010$ in. The body of the cup has all the advantages of dimensional stability and chemical resistance usually associated with phenolic moulding materials and a robust but accurate orifice has been achieved by using a brass insert which is machined to within the close tolerances of the specification.

The moulded cups may be safely used in place of the conventional metal cups with all the normal surface coating compositions, and they are resistant to attack by solvents.

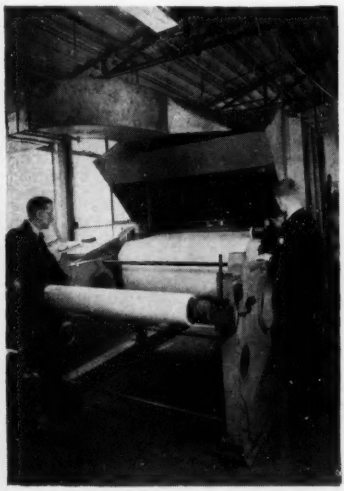
Such cups may be obtained free of charge by authentic users on application to Resinous Chemicals Ltd., Blaydon, Co. Durham.

Infra-red Curing P.V.C. Coating on Fabric

METROVICK infra-red element projectors operating at 750° C., are finding increasing uses in the field of plastics for curing and softening. In the manufacture of leathercloth, for example, it is necessary to heat a P.V.C. film on fabric without undue heating of the fabric itself and shallow penetration of infra-red is therefore desirable. The spectral absorption characteristics of this material are such that this is ensured when the fabric is irradiated by a source at 750° C.

High intensity infra-red projectors with crimped end elements for additional end heating, are used to cure P.V.C. on fabric in the manufacture of leathercloth without the aid of any other form of heating. The total loading of the three 6-ft. projectors is 45 kW or 2·5 kW per sq. ft. Vinyl Products Ltd., have incorporated these standard high intensity units into a counter-balanced framework which can be readily raised from the surface of the fabric should it be necessary to halt manufacture for any reason. The arrangement obviates the need for any complicated shuttering arrangement and is strongly recommended in such operations particularly where high intensity units are employed. The plant will cure a coating of P.V.C. six-thousandths of an inch thick on a base which is fifteen-thousandths of an inch thick at a rate of 4 yd. per min.

The Metrovick infra-red elements consist of a spiral of high-grade heat resisting wire tightly embedded by a special process in a mineral insulator, enclosed solidly in an outer sheath of $\frac{5}{16}$ in. tube of a non-scaling, non-corrodible alloy. The process ensures not only that the spiral is held immovable in the centre of the bore but also that an even thickness of insulation separates it from the sheath. The projectors themselves consist of trough reflectors in a robust frame designed for maximum strength consistent with light weight. The reflectors are constructed from high-grade aluminium sheet which has been subjected to a special anodising process to give maximum heat reflection and to protect it from atmospheric corrosion.



Metrovick infra-red curing P.V.C. coating on fabric

The British Aluminium Co. Ltd.—In accordance with his statement at the last Annual General Meeting, Mr. R. W. Cooper, M.C., Chairman of The British Aluminium Co. Ltd., has resigned his directorship as at 31st December, 1952. Viscount Portal of Hungerford, K.G., G.C.B., O.M., D.S.O., M.C., who is a director of the company, is succeeding Mr. R. W. Cooper as chairman as from 1st January, 1953. Mr. E. F. O. Gascoigne has been appointed a director of the company.

Hymatic Appointment.—Mr. J. H. Hutchinson, A.M.I.Mech.E., A.M.C.T., A.C.T. (Birm.), has been appointed to the position of Project Engineer on the technical staff of The Hymatic Engineering Co. Ltd., the compressed air equipment specialists of Redditch, Worcs. He succeeds Mr. A. H. A. Bastable who recently left the company to take up an important post in the aircraft industry.

Shell Chemicals Ltd.—Shell Chemicals Ltd. have announced that their Isopropyl Ether has been reduced in price. The new ten-ton rate is now £97 per ton delivered in 40/45 gallon returnable drums. Isopropyl Ether is being increasingly used as a solvent in surface coatings, pharmaceuticals and in numerous chemical and extraction processes.

Shell Appointments

NORMAN LUKE, London Division chemical sales manager, Shell Chemicals Ltd., since 1948, is shortly leaving to take up an appointment overseas in connection with the sales of Shell's chemical products.

Prior to joining Shell Chemicals Ltd., Mr. Luke took a Chemistry Degree at Oxford, after winning an Open Exhibition in Natural Science at Jesus College from the Royal Grammar School, Newcastle-upon-Tyne.

During the War Mr. Luke served in the Royal Corps of Signals with the Indian Army and PAI-Force in the Middle East and was demobilised in 1946 with the rank of Major.

Mr. N. Luke

Mr. S. Gordon Philips, who succeeds Mr. Luke, joined the Shell Group in 1939 and served his early days in Anglo-Saxon tankers as an apprentice. After the outbreak of War he joined the R.N.R. as a Midshipman and later transferred to the Royal Marines, rising to the rank of Major. He saw service in the Middle East and Far East, was on the staff of Flag Officer (Air) East Indies, and subsequently G.2. (Air) 33 Corps.

Returning to the Shell Group in 1946, Mr. Philips joined Shell Chemicals Ltd., and, in 1951, became assistant sales manager, London Division.

Mr. S. G. Philips

H. K. Whalley.—Dr. H. K. Whalley has resigned his post as the Development and Contracts Manager of Petrocarbon Ltd., and Director of Refinery Equipment and Speciality Co. Ltd. He joined British Industrial Solvents Ltd., on 1st January, 1953.

Tretol Ltd.—Lieut.-Comdr. J. A. Langford-Holt, M.P., has joined the board of directors of Tretol Ltd., London and Slough. At the same time, Mr. John Hurst, who has been with the company for many years, has been appointed Technical Sales Director.

"Flexiskin."—We have received from Dohm Ltd., 167 Victoria Street, London, S.W.1, a leaflet describing a new product, "Flexiskin," designed to give protection against atmospheric conditions in the storage of machine parts, delicate mechanisms, radio and television parts, etc.

United Steel.—The United Steel Companies Limited announce the following changes at the Steel, Peech and Tozer Branch, Rotherham. Mr. V. Watkins, at present maintenance manager, to be appointed deputy chief engineer. Mr. C. Wilkinson, at present assistant cold rolling mill manager, to be appointed cold rolling mill manager.

DUST COLLECTION

PERFECTAIR LTD., of 314-314a Balham High Road, London, S.W.17, have an important sphere of activity in the dust collection field and have designed and installed innumerable plants. In some of these projects, when the dust has reclaimable value, considerable financial saving has been effected. in other cases, however. the dust is simply separated, collected and taken to waste.

A plant of the latter type was recently installed at the Perfectair works, air and dust being exhausted from one of their fettling booths, separation being effected centrifugally by a high efficiency helical type cyclone, the dust being precipitated into a collection bin.

The cyclone (which was mounted on the factory roof) is illustrated here, together with the exhaust fan and interconnecting ductwork. A copy of the analysis of a dust sample from this cyclone was as follows:

Sample Received: 30th July, 1952.

Description of Sample: The sample consisted of a mixture of metal dust, grit and sand, and fluff. Total weight 35 gm.

Examination of Sample: The approximate composition was determined together with the particle size of the metal dust.

Results:

(1) *Composition*

	Sample (per cent.)
Fluff	1
Grit and sand ...	58
Metal dust	41
	100

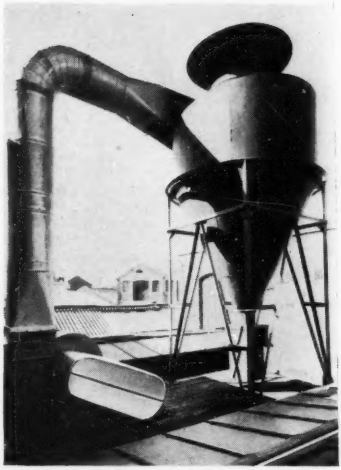
(2) *Particle Size of Metal Dust*

The particles are irregular in shape and a substantial proportion is elongated in shape. Only a negligible amount is smaller than 10μ or greater than 150μ. The approximate proportions of various sizes are:

	Per cent.
10— 20μ	5
20— 50μ	5
50—100μ	45
100—150μ	45

NOTE: 1 *Micron* (μ) = $\frac{1}{25{,}000}$ *inch.*

In view of the fact that fifty microns in diameter is usually considered the limiting size of normal visibility to the naked eye, this is considered a fine achievement.



The Perfectair Ltd., cyclone exhaust fan and connecting ductwork, installation at Balham

ZINC BULLETIN NO. 10

WE have received the tenth issue of the *Zinc Bulletin* which underlines the facts—still inadequately appreciated in some quarters—that zinc is now plentiful in supply, competitive in price and unrestricted in use. An article on the world prospects for zinc quotes the authoritative and encouraging view expressed in the now well-known Paley Report, recently presented to the President of the U.S.A. by his Materials Policy Commission. Among their forecasts for the supply and demand of all raw materials during the next twenty-five years, the experts state that the zinc supply will be adequate to meet the expected growth in demands over this period and with little or no increase in real costs. The underlying statistics are given in the form of graphic diagrams. The issue also contains a fully illustrated article on the use made of zinc alloy die castings by one of the principal British motor-car manufacturers and another article describes, with pictures and drawings, the use made at Margam of hot dip galvanised corrugated sheeting in the construction of Britain's biggest steel mill.

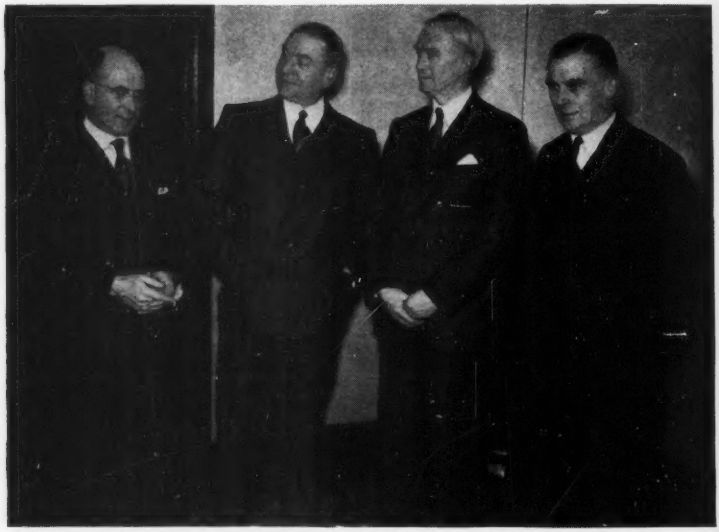
Copies of the bulletin may be obtained on request from the Zinc Development Association, Lincoln House, Turl Street, Oxford.

W. CANNING & COMPANY LTD.

SIR ERNEST CANNING, after sixty years' service, has announced that as from 1st January, 1953, he will relinquish his office of joint managing director of W. Canning and Co. Ltd., but will continue to be chairman of the board of directors.

Mr. G. A. Pope (joint managing director) has been appointed deputy chairman from 1st January, 1953, and will continue to be joint managing director. Mr. F. H. Ewens (financial director) has been appointed joint managing director from the same date.

The following four additional directors have been appointed with effect from 1st January, 1953: Mr. E. G. Catton; Mr. H. C. Clements; Mr. S. S. Dawson; Mr. E. L. Masek. All of the additional directors have been with the company for many years and at present hold prominent executive positions.



The four new directors. (Left to right) Mr. E. L. Masek, Mr. S. S. Dawson, Mr. E. G. Catton and Mr. H. C. Clements

"E.R.W."

UNDER this title the latest addition to the 1952 release of technical films tells in graphic form of the production of welded steel tube by the welding of the abutting edges of cold rolled steel strip, cold formed into a cylinder, thus "E.R.W." which stands for "Electric Resistance Weld." Produced by Ace Distributors for Stewarts and Lloyds Ltd., "E.R.W." has a running time of 31 min. and is available in black and white 16 mm. sound and 35 mm. sound.

After briefly touching on the steel and strip making processes the film covers the E.R.W. process in detail and ends with a series of "shots" showing some of the many uses to which Stewarts and Lloyds' E.R.W. tube has already been put.

The production of the film is of the high standard to which technical audiences have become accustomed, the shots are well conceived and the commentary is factual and at no time distracts from the operation being shown. Full details are available from The Publicity Manager, Stewarts and Lloyds Ltd., Brook House, Upper Brook Street, London, W.1.

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Subscription Rate 30s. per annum.
Published by Arrow Press Ltd. at 157 Hagden Lane, Watford, Herts.
Telegrams: "Techpress, Watford." Telephone: Gadebrook 2308/9.

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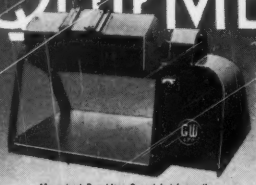

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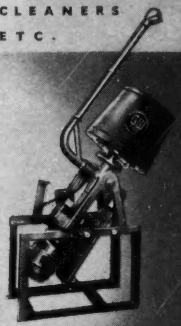

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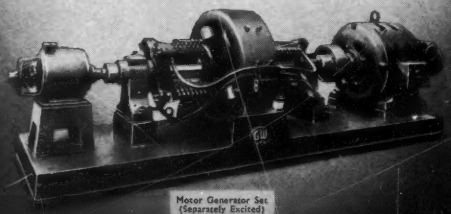

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